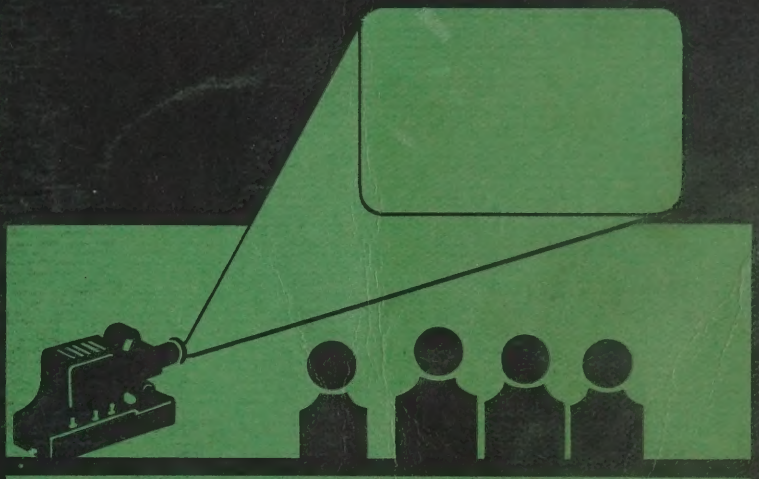
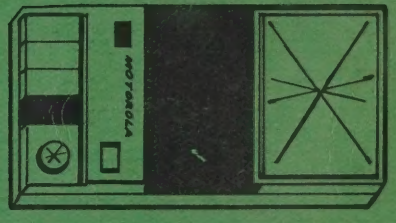
MAV-PACK®

MOTOROLA
AUDIO-
VISUAL
PACKAGE

TRAINING SCHOOL





NATIONAL
MOTOROLA
COMMUNICATIONS
SERVICE

COURSE TXA

TONE REMOTE CONTROL SYSTEM FOR BASE STATIONS, MODULE CIRCUITS AND SERVICING

MOTOROLA Communications and Electronics Inc.
Produced by TECHNICAL TRAINING DEPARTMENT

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.
Motorola Technical Training Department

MAV-PACK COURSE TXA

TONE REMOTE CONTROL SYSTEM FOR BASE
STATION MODULE CIRCUITS AND SERVICING

CASSETTE "INDEX-LOCATOR"

To locate any specific section of the lecture recording relative to any frame on the filmstrip.

Note: "Elapsed Time" is elapsed time in minutes and seconds of each Cassette from start of tape to the beep for changing to the next frame.

Set up and focus on "Focus Frame". Move projector to next frame, a black frame; start recorder and projector. Advance projector one frame each time you hear a beep. Keep frames synchronized with the frame references by the instructor.

Elapsed Time	Side No.	Filmstrip Frame No.	Title of Section/Frame
Start	1	—	"Turn On"
0:13	1	—	First "beep" Title Frame—MAV-PACK Course TXA—Tone Remote Control System for Base Station Module Circuits and Servicing
2:50	1	Ne[illegible]	Photo—Base Station Training System
4:35	1	1	Title—Course TXA—Tone Remote Control System for Base Station Module Circuits and Servicing
4:45	1	2	Photo—Tone Console and Hand
4:50	1	3	Drawing—Base Station Antenna
4:57	1	4	Photo—Console Speaker
5:00	1	5	Drawing—Tower Light
5:10	1	6	Title—Why Tone Remote Control?
5:30	1	7	Drawing—Telephones
5:40	1	8	Photo—Touchtone Telephone
6:20	1	9	Photo—Telephone Lines
7:07	1	10	Photo—Tone Console
7:20	1	11	Title—Available in Compa and Upright from Low Band to 960
7:40	1	12	Chart—D.C. Remote Control Functions
8:05	1	13	Photo—Eleven Functions
8:25	1	14	Chart—Eleven Functions
11:00	1	15	Photo—Compa Station and Tone Console
11:50	1	16	Photo—Tone Remote Console
12:40	1	17	Photo—Remote Control Chassis and Tone Console
12:50	1	18	Photo—Tone Remote Control Chassis
13:17	1	19	Photo—Guardtone Decoder
13:47	1	20	Photo—F1-PL and F2-R2 Decoders
14:25	1	21	Photo—Options Decoder
15:10	1	22	Photo—Wild Card Decoder
15:53	1	23	Photo—Line Driver and Station Logic Decoders
16:30	1	24	Title—Tone Coding
16:40	1	25	Title—Basically a Two Tone Sequential System, etc.
17:15	1	26	Title—First Tone is Always the Same
17:45	1	27	Title—Second Tone is the Function Tone
18:30	1	28	Title—Review
19:05	1	29	Title—Two Types of Commands
19:23	1	30	Drawing—Function Command Sequence Number One
20:15	1	31	Drawing—Function Command Sequence Number Two
21:25	1	32	Drawing—Function Command Sequence Review
21:55	1	33	Drawing—Transmit Command Sequence Number One
23:35	1	34	Drawing—Transmit Command Sequence Number Two
24:15	1	35	Drawing—Transmit Command Sequence Number Three
24:55	1	36	Drawing—Transmit Command Sequence Review
28:15	1	—	End of Side 1
0:00	2	—	**Start of Side 2**
0:20	2	37	Title—Simplified Block Diagrams
0:34	2	38	Simplified Block Diagram—F1-F2 Selection and Transmit
4:15	2	39	Simplified Block Diagram—"P.L." Disable Command
8:26	2	40	Simplified Block Diagram—Mute Receiver Two
13:10	2	41	Title—Logic Symbols
13:50	2	42	Drawing—Inverter
14:55	2	43	Drawing—And Gate
16:13	2	44	Drawing—Or Gate
17:30	2	45	Take a Break
17:45	2	46	Title—Detailed Functional Block Diagram
18:27	2	47	Overall Functional Diagram
19:35	2	48	Title—Transmit F1
20:05	2	49	Line Driver Block Diagram Transmit Audio
20:47	2	50	Station Logic Module Transmitter Audio
21:13	2	51	F1-PL Module Transmitter Audio
21:30	2	52	Line Driver Module Guardtone and Function Tone Path
22:15	2	53	Guardtone Module High Level Guardtone Line AGC
23:40	2	54	Guardtone Module Activity Checker
24:20	2	55	Guardtone Module High Level Guardtone Line Push-to-Talk and Gated AGC
26:05	2	56	Station Logic Module High Level Guardtone
28:20	2	—	End of Side 2
0:00	3	—	**Start of Side 3**
0:05	3	57	Station Logic Module High Level Guardtone
3:40	3	58	Guardtone Module High Level Guardtone and 350 Millisecond Window
4:25	3	59	Guardtone Module High Level Guardtone Pre-filter and Decoder Bias Switch
5:15	3	60	F1-PL Control Module High Level Guardtone Enable Window
6:55	3	61	Guardtone Module Function Tone High
8:10	3	62	F1-PL Module Function Tone Enable
9:15	3	63	F1-PL Control Module Switched 8.8 Volts
10:10	3	64	F1-PL Control Module Function Tone Decoded
10:25	3	65	Title—On the Air
11:25	3	66	Guardtone Module Low Level Guardtone Gated AGC
12:55	3	67	Guardtone Module End of Transmit Reed Quench
13:05	3	68	Station Logic Module End of Transmit
13:33	3	69	F1-PL Control Module End of Transmit
13:50	3	70	Title—Off the Air
14:00	3	71	Title—Review
15:55	3	72	Title—Transmit F2
17:45	3	73	F2-R2 Mute Control Module F2 Transmit
19:45	3	74	Title—Function Commands
21:20	3	75	Title—"P.L." Disable Function
22:25	3	76	F1-PL Control Module "P.L." Disable
23:45	3	77	F1-PL Control Module "P.L." Enable
25:40	3	78	Title—Mute Receiver Number Two
25:50	3	79	F2-R2 Mute Control Module Mute Receiver Two
28:40	3	—	End of Side 3
0:00	4	—	**Start of Side 4**
2:00	4	80	F2-R2 Mute Control Module Unmute Receiver Two
3:15	4	81	Drawing—R1 Priority Kit
4:40	4	82	Title—Options Decoder Block Diagram
4:50	4	83	Squelch Control Module Maximum Squelch
8:20	4	84	Squelch Control Module Threshold Squelch
9:55	4	85	Title—Wild Card
10:00	4	86	Wild Card Module Decoder Number One
12:50	4	87	Wild Card Module Decoder Number Two
13:50	4	88	Title—Local Control Transmit
14:00	4	89	Local Control Local Transmit
14:30	4	90	F1-PL Control Module Local Transmit
15:20	4	91	F2-R2 Mute Control Module F2 Local Transmit
16:45	4	92	Station Logic Module Local Transmit
17:15	4	93	F1-PL Control Module Line Priority
19:00	4	94	Take a Break
19:45	4	95	Title—Tone Remote Control Schematic Study
20:00	4	96	Photo—Line Driver
21:30	4	97	Schematic—Line Driver Module Intercom Section
24:05	4	98	Line Driver Module Audio Section
29:45	4	—	End of Side 4
0:00	5	—	**Start of Side 5**
0:05	5	99	Photo—Station Logic
1:40	5	100	Schematic—Station Logic Module Audio Section
4:15	5	101	Schematic—Station Logic Module Switching Section
11:00	5	102	Photo—Guardtone Module
12:10	5	103	Schematic—Guardtone Module Input Circuit
15:15	5	104	Schematic—Guardtone Module Audio Amplifiers
18:25	5	105	Schematic—Guardtone Module Activity Checker Circuit
20:36	5	106	Schematic—Guardtone Module Fourth and Fifth Amplifiers
22:25	5	107	Schematic—Guardtone Module Push-To-Talk Circuit
25:15	5	—	End of Side 5
0:00	6	—	**Start of Side 6**
0:20	6	108	Schematic—Guardtone Module Pre-filter and Decoder Bias Switches
5:30	6	109	Schematic—Guardtone Module Gated AGC
9:15	6	110	Photo—F1-PL Control Module
10:15	6	111	Schematic—F1-PL Control Module Enable Circuit
11:20	6	112	Schematic—F1-PL Control Module Input Circuit
12:05	6	113	Schematic—F1-PL Control Module F1 Decoder
14:50	6	114	Schematic—F1-PL Control Module Line Control Priority Gate
17:00	6	115	Schematic—F1-PL Control Module "P.L." Disable Decoder
20:15	6	116	Schematic—F1-PL Control Module Line Transmit Priority Gate
23:45	6	117	Schematic—F1-PL Control Module Transmit Notch Filter
25:20	6	—	End of Side 6
0:00	7	—	**Start of Side 7**
0:05	7	118	Schematic—F1-PL Control Module Receiver Notch Filter
1:15	7	119	Photo—F2-R2 Mute Control Module
2:05	7	120	Schematic—F2-R2 Mute Control Module F2 Decoder
5:15	7	121	Schematic—F2-R2 Control Module Mute Decoders
7:55	7	122	Photo—Squelch Control Module
8:45	7	123	Schematic—Squelch Control Module Input Circuits
9:40	7	124	Schematic—Squelch Control Module Decoder Circuits
11:00	7	125	Schematic—Squelch Control Module Attenuator Circuits
12:55	7	126	Photo—Wild Card Module
14:00	7	—	End of Side 7
0:00	8	—	**Start of Side 8**
0:05	8	127	Schematic—Wild Card Module Input Circuits
1:20	8	128	Schematic—Wild Card Module Decoder Circuits
3:15	8	129	Tone Remote Control Servicing Techniques
3:45	8	130	Photo—TLN8799A Extension Board
4:35	8	131	Photo—TEK-38 Base Station Module Servicing Adapter
5:45	8	132	Photo—TEK-38 and F1-PL Control Module
8:30	8	133	F2-R2 Mute Module Servicing Chart
9:45	8	134	Photo—TEK-38 and F2-R2 Mute Module
10:25	8	135	Chart—Options Decoder Service Chart
11:20	8	136	Photo—TEK-38 and Options Decoder
13:10	8	137	Credits Frame
13:20	8	138	The End
14:10			End of Music

6-25-70

MOTOROLA
COMMUNICATIONS and ELECTRONICS, INC.

TECHNICAL
TRAINING
DEPARTMENT

PREFACE

THE NEW "MAV-PACK" TRAINING PACKAGES

WIDESPREAD NEED FOR TECHNICAL TRAINING

The need for extensive technical training of Service Technicians has made it necessary for Motorola to develop a new and additional type of training on its Communications products.

Recognizing the increasing complexity of new products and how many there are, all of which is made possible by solid state developments, we have conducted over 1,000 schools in a single year.

But, that is not enough. We cannot reach a large percent of the Technicians in the business. Many just cannot make it into our schools, even though schools were held in over one hundred cities.

Every Technician can benefit by training on a new product. In fact, this training is about the only way he can keep abreast of todays rapid development in technology. Obviously the "new" is stressed in our training packages.

"MAV-PACK"
(MOTOROLA AUDIO-VISUAL TRAINING PACKAGE)

Our new MAV-PACK technical training package does a thorough and excellent job of training. It makes use of Cassette recordings and a synchronized filmstrip, plus a text containing theory, circuit analysis and servicing techniques. The text also contains numerous fold-out schematics.

MAV-PACK is a complete technical training course on a specific product. It is designed to reach every Service Technician who services Motorola equipment.

SEVERAL WAYS TO TEACH MAV-PACK PACKAGES

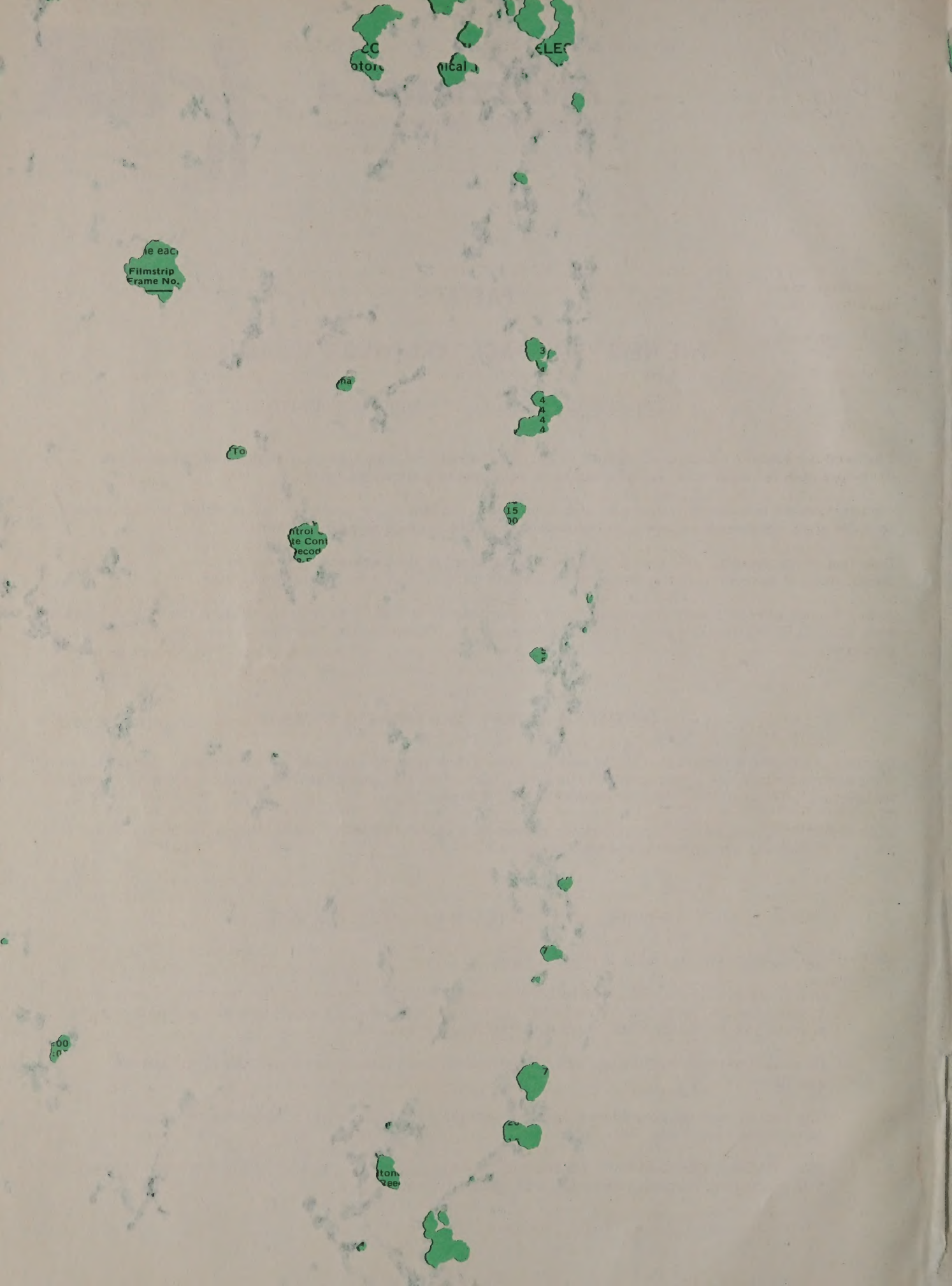
MAV-PACK packages can be taught in several ways:

1. In a classroom lecture-demonstration type school, like Motorola field men have been conducting. In this case the instructor would lecture to replace the cassette recordings, or use selected parts of them and would make full use of the new filmstrip and text.

   He could interrupt the film and add pertinent field experiences, or ask questions and answer questions, or

2. One man in your shop could be selected to run the show for a group stopping for reviews and discussions of circuits, etc., or

3. MAV-PACK can be used for "self-teaching" by one man or a group, letting it do the whole job. It is a complete training course and will stand on its own.


Filmstrip
Frame No.

IN-SHOP TRAINING, NOW, NEXT YEAR, ANYTIME

MAV-PACK is the answer to in-shop training. Now you no longer have to travel, or close the shop, or lose time to get training on a product. It is the answer to training on new products.

Build a library of these packages. You can then train a new man anytime, or use the material as a refresher, or even to study a circuit for some specific problem in a unit.

HOW YOU SHOULD USE THIS MAV-PACK PACKAGE

There are a few things you should know about MAV-PACK and certain techniques you should use, in order to get the most value from it. Let's assume you are going to go through it alone. The same things apply, regardless of how many are participating.

HOW TO OBTAIN MAV-PACK PACKAGES:

MAV-PACKS are available in a continuing series on new products. You can purchase them from your Motorola Parts Department, at nominal prices. See your Buyers Guide.

MAV-PACKS CONTAIN:

1. About three (3) one-hour Cassettes of the C-60 type. On these are recorded the voice of your Technical Training Department Training Specialist, as his lecture takes you through Features of the equipment, through Circuit Analysis, how it works and Servicing Techniques.

2. Second, a 35mm Filmstrip, showing the Equipment, Schematic Diagrams, Block Diagrams, Servicing Techniques and Test Equipment. These are unique, in that colors are used for signal flow and there is no glaring white background. Instead, the background is dark.

   Note that the Filmstrip is synchronized with the Cassette tapes by "beeps" recorded right in the audio track.

   We recorded the "beeps" in the track to keep the cost down, to put this package within reach of every Technician. Thus, we can use both tracks on the Cassette, turning it over at the end. This reduces the number of Cassettes by one-half.

   THIS REQUIRES THAT YOU LISTEN FOR THE "BEEP" AND PUSH THE BUTTON, OR ROTATE THE PROJECTOR, TO CHANGE TO THE NEXT FRAME.

   RECORDER AND PROJECTOR
   We seriously considered using a two-track approach, with "beeps" on the second track, inaudible in the sound track. Plus, an automatic frame advance. This would have required a much more expensive 2-track recorder-playback unit, plus an automatic decoder-stepper for the strip projector. These would have quadrupled the costs for equipment and doubled the number of Cassettes.

   Now, with the MAV-PACK approach, you can use the lowest cost Cassette (standard) recorder-playback unit and the lowest cost manual filmstrip projector. These can be purchased or leased locally from your camera shop.

   See your Buyers Guide for a "suitcase" package made available for your convenience. This contains a Motorola CF-30 Cassette Recorder and a Standard 300 Watt Filmstrip Projector. The latter has a choice of remote control or manual rotation.

3. Third, two (2) copies of the Book with the green cover. More are obtainable through your Motorola Parts Department, provided you have already purchased the MAV-PACK and can use them for training as intended.

   This book, developed by the same man who recorded his lectures, contains:

   I Introduction to the course itself

   II Course Outline

   III List of Equipment for a school

   IV Text on theory, circuit analysis, servicing.

V Several Foldout Schematics, and other reference material.

VI Cassette "Index-Locator" pages in the front, to help you locate any section you wish to repeat or study. This shows the elapsed time from start on a Cassette at the "beep" for any frame you are looking for.

Note also that the Instructor nearly always states the next frame number. Thus, by using the indicated elapsed time and stopping to hear a frame number, you can quickly find a passage you want.

VII A set of questions for you to answer and turn in to your shop manager. There is a sealed packet of answers for the manager to open and grade your examination.

WHAT YOU DO:

So get yourself involved! Get all you can out of this MAV-PACK. Be alert. Listen for the "beeps" and change slides when they occur. When a Cassette comes to an end, turn off the unit and turn it over, or change to the next.

Adjust the focus of your projector lens for best sharpness as required.

Get involved! Follow the instructor and the filmstrip with each change of context. If he tells you to look up a reference in the book, do it! If he asks a question, try to answer it, for yourself. When he asks you to break and write answers to the set of questions, do it, right then. Or he may suggest you write a certain note on a schematic. If he suggests you take a few minutes break, or go have a cup of coffee, take the break. You can pull yourself away! Do it!!! GET YOURSELF INVOLVED.

Be sure to look through the book and all the written materials so you can follow them, or turn to them quickly, during the session.

Always have sufficient light in the room so you can read your test and follow schematics. Maybe a bench light or two, or a table lamp off to one side.

If you have a subject unit available, it is most important to have it alongside while taking the course. Look it over first, if you are not familiar with it.

NOW, LET'S GET STARTED:

1. Locate the Cassette having Side Number One (1) and place it in the recorder.

2. Thread the starting end of the Filmstrip in the projector, turn it "on", rotate the feed to the "focus" frame. Using the "framing lever", center the frame on the screen, then focus the lens.

3. Advance to the next dark frame and turn the recorder on "play".

4. When you hear the first "beep" advance to the next frame.

5. Each time you hear a beep, advance to the next frame. Watch frame numbers in lower right hand corner, so you can stay synchronized.

MOTOROLA
COMMUNICATIONS and ELECTRONICS, INC.

TECHNICAL
TRAINING
DEPARTMENT

TONE REMOTE CONTROL SYSTEM FOR BASE STATIONS, MODULE CIRCUITS AND SERVICING

COURSE TXA

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I. INTRODUCTION

II. COURSE OUTLINE

III. TEXT

MOTOROLA
COMMUNICATIONS and ELECTRONICS, INC.

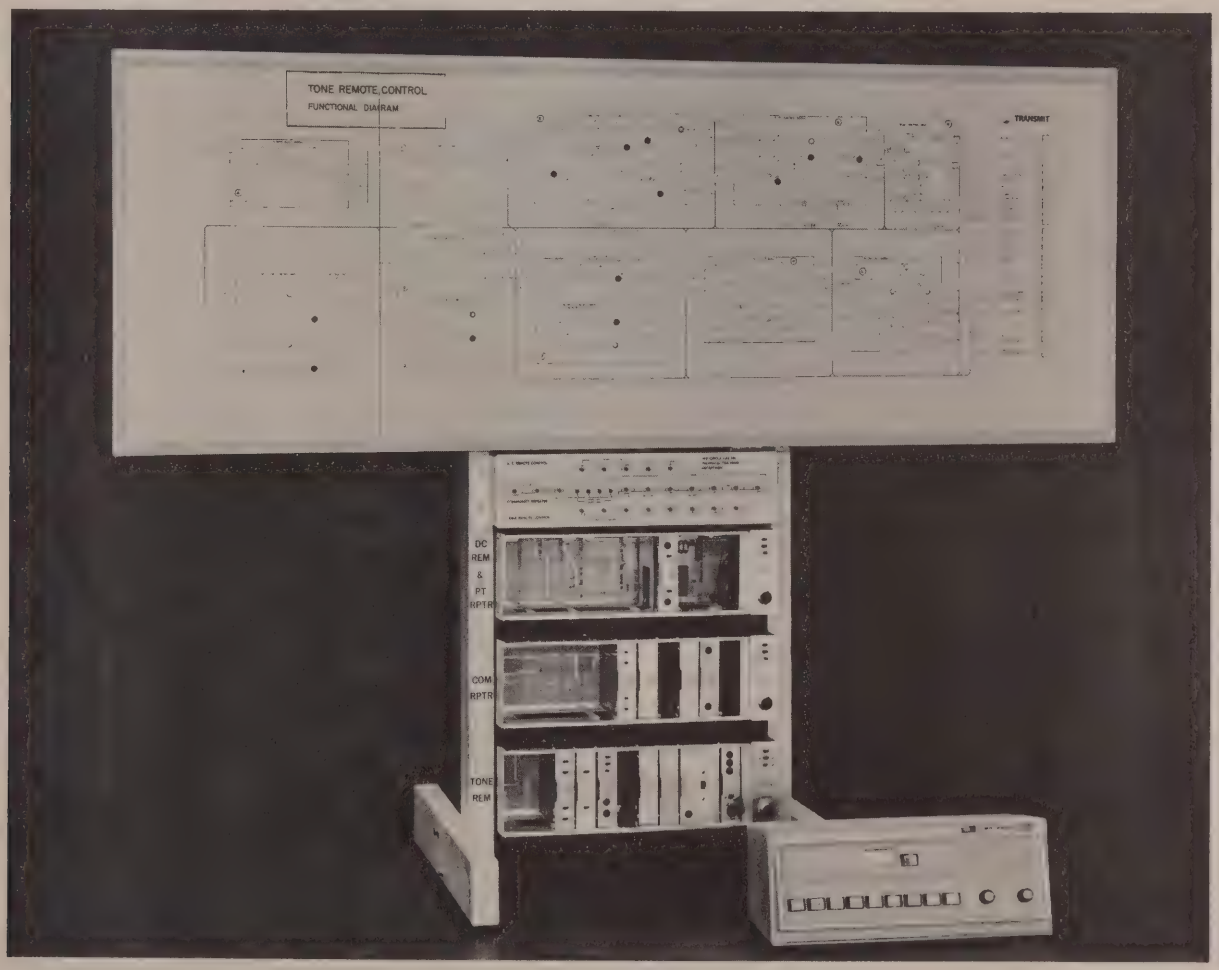
TXA - 1
TECHNICAL
TRAINING
DEPARTMENT

PART I – INTRODUCTION

MAV-PACK COURSE TXA - Tone Remote Control System for Base Station, Module Circuits and Servicing is complete in itself and is designed to stand on its own. It may be presented in several ways. One man or a group of men can run the program on their own using the filmstrip and tape cassettes provided. Another method of presentation is through the Motorola conducted school.

When this course is presented by a Motorola Field Technical Representative, he has not only the filmstrip and tape cassettes at his disposal, but also a Tone Remote Control Training System as seen in the photo. These systems are completely operational and switching actions throughout are indicated by green and red colored lights. Through a system of inhibit switches, circuit action may be stepped along and stopped by the instructor, giving the student a close look at each major action on the system sequentially until the function is completed.

This demonstrator is also used for D.C. remote control, R.T. repeater and community repeater training sessions.



BASE STATION TONE REMOTE CONTROL TRAINING SYSTEM USED IN MOTOROLA CONDUCTED FIELD SCHOOLS.

In servicing Base Station Tone Remote Control, a good working knowledge of the total system is the Service Technician's most important service aid. Without this knowledge even the most simple problems can become extremely difficult and time consuming. MAV-PACK Course TXA contains the information necessary to gain that system knowledge.

MAV-PACK Course TXA proceeds through the Base Station Tone Remote Control System from basic introductory information through the tone coding scheme, simplified block diagrams, logic symbols, a complete system description via the functional diagram, and a schematic study.

This Study Guide will also be useful at a later date as a reference to help solve some of those tough problems.

Besides all of the material covered in the filmstrip and tape cassettes, this Study Guide also contains six more tone remote control module sections, thus providing information on all Base Station Tone Remote Control Modules currently available.

MOTOROLA
COMMUNICATIONS and ELECTRONICS, INC.

TONE REMOTE CONTROL SYSTEM FOR BASE STATIONS, MODULE CIRCUITS AND SERVICING

COURSE TXA

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MOTOROLA
COMMUNICATIONS and ELECTRONICS, INC.

TONE REMOTE CONTROL SYSTEM FOR BASE STATIONS, MODULE CIRCUITS AND SERVICING

COURSE TXA

PART III

TEXT

BASE STATION TONE REMOTE CONTROL

FIGURE 1. TONE REMOTE CONTROL COMPA-STATION

I. INTRODUCTION

Tone Remote Control-Two tones in a short sequential burst is all that is necessary to select a frequency and to turn on a remotely located base station transmitter or to mute a second base station receiver, or to remotely override tower light control in special conditions, or, for that matter any function designed to be used with Tone Remote Control.

Why Tone Remote Control? Why change from that old standby, the D. C. Control system that has been used for so long? Well, remote control usually depends upon telephone lines, and that's where the answer lies. So lets look at what the telephone services are doing.

One item really stands out—that is the exciting new telephone line development that is spreading across the nation. Its called "Touch Tone" It means carrier operation. Now, telephone numbers that you dial are sent as coded A. C. not D. C. currents as in the past.

The telephone company is going to carrier operation for one main reason—that's economics, Cooper wire, particularly, gets more expensive each day, while multiplex microwave stations, amplifiers, etc., are getting more economical by comparison.

As you may know, with the older method of telephone operation, a D. C. signal is transmitted over copper telephone wires having D. C. continuity. Unfortunately, these lines are expensive to install and maintain and often inferior for good quality transmission. Not only that, they are unavailable in some areas; and, as mentioned earlier, the phone companies are moving to obsolete them.

Any time a two-way radio user requires a remotely controlled transmission, and that remote station transmitter depended on D. C. command functions—as those just described do—the signals from his dispatch point to the transmitter must be carried over some of those copper wires with D. C. continuity. We, like the telephone company, have always used D. C. remote control.

Now, for the first time, we do not need D. C. continuity provided by copper wires. We have completely new system of remote control for base station operation, and it is called Tone Control.

II. FEATURES

Tone Control options are available for all Motorola Compa-Stations and Upright Base Stations from low band, through high band, 450 MHz, and all the way up to 960 MHz, enabling the customer to issue commands over any telephone system whether D. C. continuity is available or not.

In the past, signalling from a remote control base via D. C. lines limited the dispatcher to only four basic functions. These functions are: transmit on frequency one, transmit on frequency two, disable "Private Line", and mute receiver two.

But with Tone Control, the amount of functions available is increased to eleven without hardly trying; and would you believe that there is room for at least three more, allowing special modifications or "SP"s to be added very easily.

STANDARD FUNCTION TONE FREQUENCIES

FREQ.	FUNCTION
2050	"Private - Line" Disable
1950	Transmit F1
1850	Transmit F2
1750	R2 Mute or (Receive F1)*
1650	R2 Unmute or (Receive F2)*
1550	"MAX" SQUELCH or REPEATER "OFF" or "PL" ON
1450	"MIN" SQUELCH or REPEATER "ON" or "PL" OFF
1350	"Wildcard" I ON
1250	"Wildcard" I OFF
1150	"Wildcard" II ON
1050	"Wildcard" II OFF

*C2 R2 Receiver Frequency Selection

FIGURE 2.

In Figure 2 we'll look at those eleven functions available on Tone Remote Control. The chart lists the eleven tone control functions in the order of their function tone frequency. For instance, at the top, controlled by 2250 Hz, is a "Private Line" disable function. Transmit F1 is 1950 Hz, transmit F2 is 1850 Hz. Mute receiver number two un—mute. Notice that this pair of frequencies, 1750 HZ and 1650 Hz, may be used for more than one purpose—either mute and un—mute receiver two, or receive F1 and receive F2. The second option would be used with a C2—R2 station—that is 2 frequency transmit, 2 frequency receive—previously unheard of with D. C. control. 1550 and 1450 Hz are used for option decoders. As indicated on the chart, 1550 Hz will control maximum squelch. The squelch control function allows the dispatcher to remotely control the carrier squelch on his base station to either of two preset settings. Another option available for this pair of tone frequencies is repeater "on" and "off" control so operator can remotely set up or knock down a repeater, and, finally, "P. L." on—off control to allow station operation in either the "P. L." or carrier squelch mode for extended periods of time. The last four frequencies, 1350, 1250, 1150 and 1050 Hz are used for "Wild Card" functions. The "Wild Card", as the name implies, can be used for anything that the customer so desires—that is, turn on and off pumps, lights generators—all from the dispatch point. Anything that can be controlled by a transistor by Tone Remote Control using the "Wild Card" function. The "Wild Card", itself, is a modular decoder which has four separate function outputs—two "on" functions and two "off" functions.

Well, how about that for a Remote Control system? No need for D. C. continuity in the control lines, and eleven functions instead of only four as in the past.

But that's not all. The Tone Remote Control system is completely modular. All decoder circuits are on plug-in cards for easy installation and servicing.

Would you believe no tone levels to set? That's right! Tone encoder levels are set automatically when the Remote Console Line Output Control is adjusted for voice levels, and all decoder level variations are handled by built-in AGC circuits.

Beside all of the above features, the Motorola Tone Remote Control system will operate with up to 30 DB line loss.

All this adds up to a great new control system with more flexibility, greater reliability, and better serviceability than in the past.

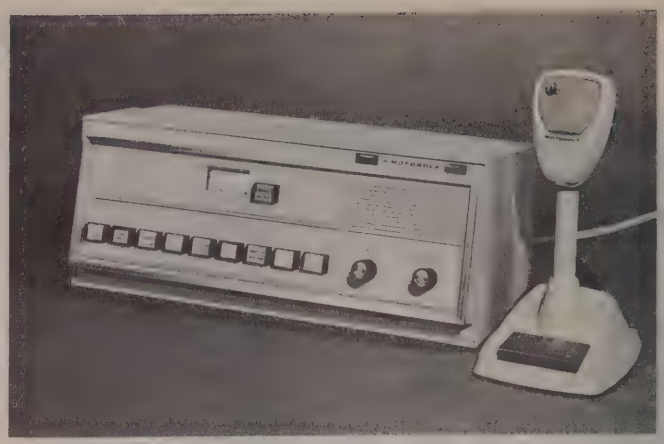


FIGURE 3. THE T1366 SERIES TONE REMOTE CONTROL CONSOLE

Looking at the Tone Remote Control system, we find that the control tones, themselves, the actual heart of the system, are generated by the T1366, T1367 series Remote Console. This console looks very much like the old T1360, and it is. From the outside, there is no apparent difference. The labeling on the controls is somewhat different , but the external appearance is exactly the same as the original T1360 series Remote Console. Details on the Tome Console are covered in Course TGA-Tone Remote Console.

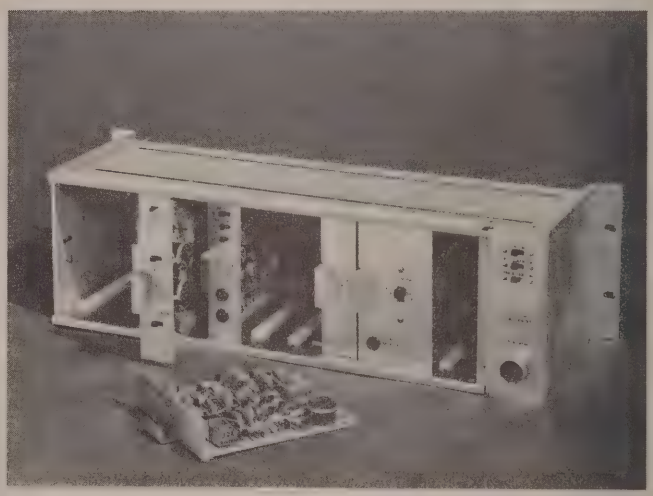


FIGURE 4. TONE REMOTE CONTROL CHASSIS REMOVED FROM THE BASE STATION. NOTE THE PLUG-IN MODULES.

The Console output is connected to the base station remote control chassis via telephone lines or other carrier such as an RF link, microwave, or otherwise.

In Figure 4, the remote chassis is removed from the base station cabinet. The remote chassis houses the plug-in circuit modules necessary to decode the tone signals from the Remote Control Console and control the various functions of the base station.

Lets take a close look at the modules that are incorporated into this remote control chassis.

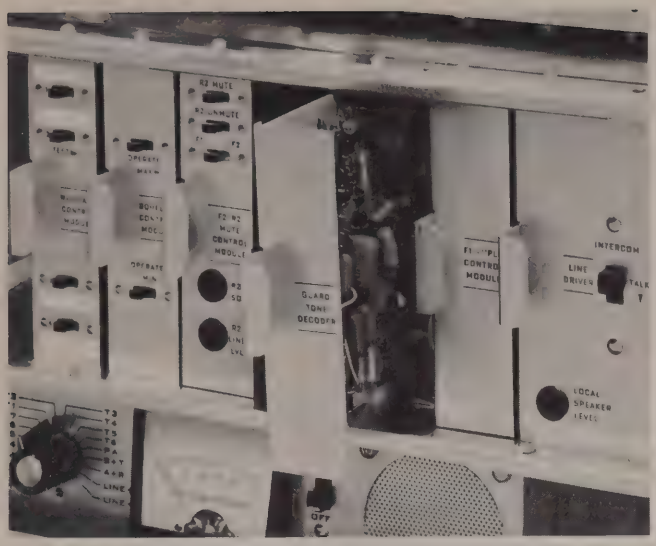


FIGURE 5. THE GUARDTONE DECODER MODULE PARTIALLY REMOVED FROM THE REMOTE CONTROL CHASSIS.

The first one that we see - in Figure 5 - is the Guardtone Decoder. The Guardtone Decoder is the nucleus of the Tone Control system at the base station, and without it the system would be completely inoperative. This module handles all incoming tones, and decides if the basic code is correct before allowing "push-to-talk" information and an enabling signal to be routed to all the function decoders.

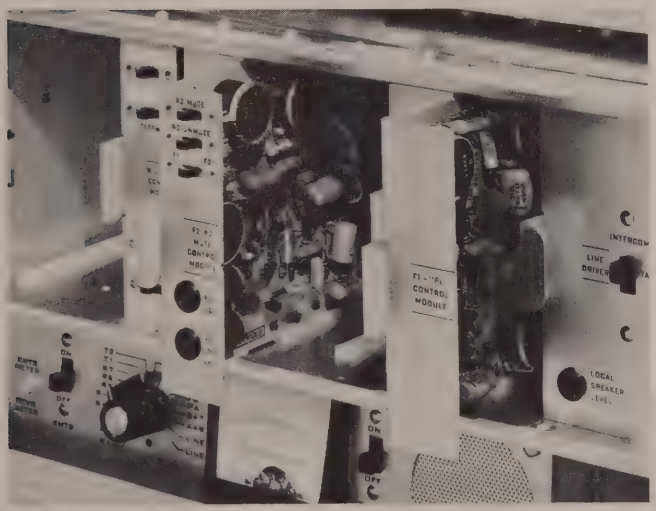


FIGURE 6. THE F1-PL CONTROL MODULE ON THE RIGHT AND THE F2-R2 MUTE CONTROL MODULE ON THE LEFT.

Now, beginning with Figure 6, lets take a look at some of the function decoder modules. The function modules include the F1-PL decoder shown at the right. This module selects the F1 frequency in a 2 frequency system, and also, upon command, will temporarily disable the "Private Line" tone coded squelch of the base receiver. The F2-R2 Module on the left will select the F2 transmitter frequency, and is also capable of muting and un-muting a second receiver for an extended period of time.

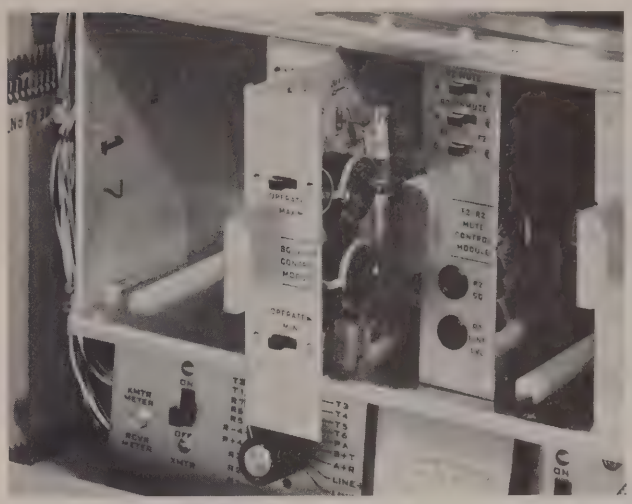


FIGURE 7. SQUELCH CONTROL MODULE-NOTE THE FRONT PANEL OPERATE SWITCHES

The module partially removed in Figure 7 is an Options Decoder. This decoder is set up for use in three common situations. These optional uses are remote squelch control, remote repeater set up and knock down, and "P. L." squelch on-off control. The same module is used in each case; however, the labeling and electrical connections are changed to fit the job. As can be seen, the Options Decoder here is used for carriers squelch control and is capable of adjusting the squelch at the remote base station location to either of two pre-set conditions.

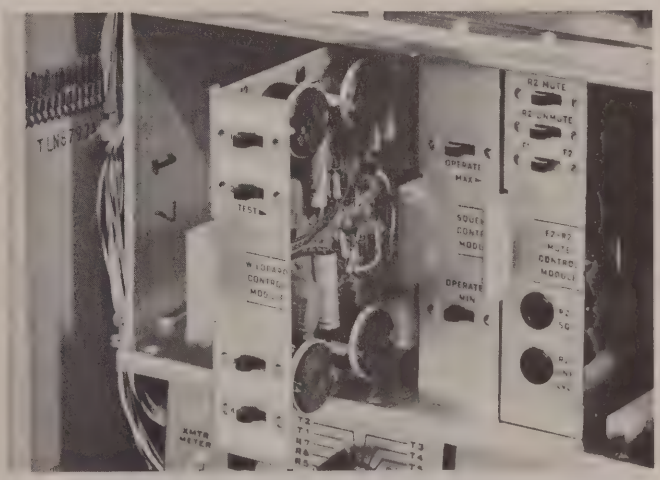


FIGURE 8. THE WILDCARD MODULE HAS FOUR INDIVIDUAL DECODER CIRCUITS EACH WITH A LOCAL TEST SWITCH.

In Figure 8, we see the "Wild Card". As the name indicates, the "Wild Card" Module may be used for almost any purpose. By using four separate

function tones, it can provide two complete on-off functions - either with transistor switch outputs capable of grounding a 100 milliamp circuit, or, with an Optional Relay Kit for higher current purposes. Typically, the "Wild Card" Module is used for controlling items such as tape recorders, generators, heaters, antenna selections, tower light override control, or for anything—you name it! The "Wild Card" is just that! It can be used for any purpose that the customer so desires.

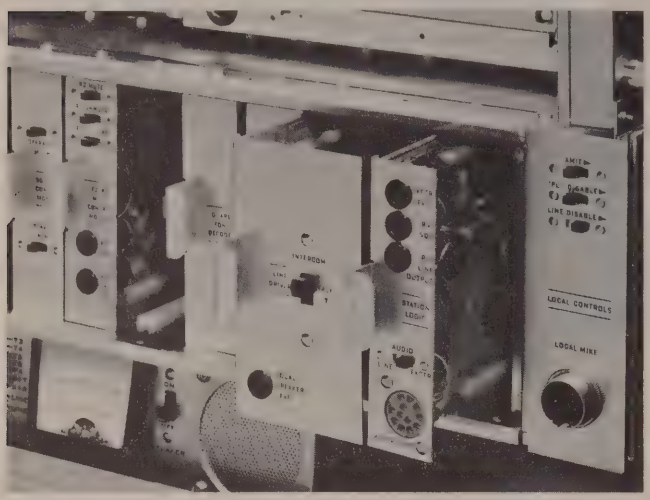


FIGURE 9. THE STATION LOGIC MODULE HAS RECEIVER #1 CONTROLS AND THE TRANSMITTER EXCITER LEVEL CONTROL ON ITS FRONT PANEL. ALSO NOTE THE METERING SOCKET. NOTE THE INTERCOM SWITCH ON THE LINE DRIVER MODULE.

Two circuit modules that are standard in all Tone Remote Control systems and also D. C. Remote Control systems are seen in Figure 9. They are the Station Logic and the Line Driver Modules. The Line Driver Module provides an interface for the base station with the 600 ohm telephone lines, while the Station Logic exercises push-to-talk, antenna relay, receiver muting, and channel element control. It also contains the line output, squelch, and exciter level controls.

III. TONE CODING

A. INTRODUCTION

Before we can delve into the details of the control circuitry, we must first understand the coding system used in Tone Remote Control.

Basically, Tone Control is a two tone sequential system, with a time base.

The first tone is always the same - always! It is 2175 Hz or cycles, whichever you prefer. It is called the Guardtone. Remember that! Its purpose is to seize control of the station, to generate a push-to-talk signal, and to provide an acceptance time—or a "Window", so to speak - during which time the function decoders may operate.

The second tone burst is the function tone. Its frequency is different for each function. The function tone frequencies range from 2050 Hz on the high side to 1050 Hz on the low side, with 100 Hz spacings—a total of eleven standard function tones. Actually, the system is quite capable of operating down to 650 Hz, and there are four more tones set up below 1050 Hz. However, these would be used for SP's or special products, and are not part of the standard tone system.

Let's review! A two tone sequential system—the first tone is always the same for any command. It is called the guardtone—2175 Hz. The second tone is a function tone and its frequency will change, determined by the function that it is commanding. Each function has a different tone frequency. There are eleven standard function tones, ranging from 2050 Hz on the high side to 1050 Hz on the low side.

Now, lets take a look at the type of commands involved in Tone Remote Control. There are two distinct types of tone commands. The first is any function other than transmit, and the second is a transmit command.

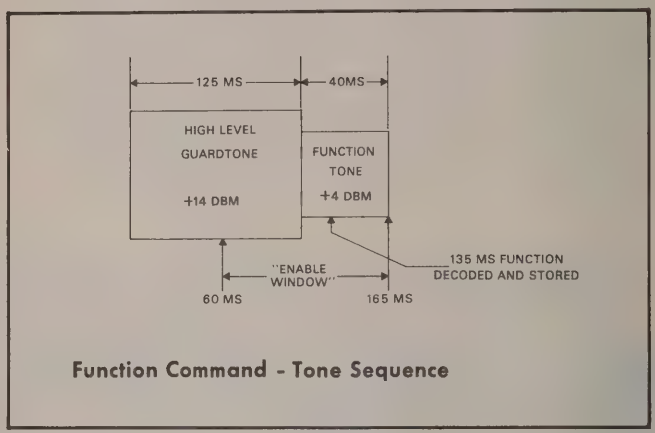


FIGURE 10.

B. FUNCTION COMMAND SEQUENCE

First—in Figure 10—take a detailed look at the function command. When a function command button is depressed at the Tone Remote Console, a self-completing tone sequence is initiated.

A high level guardtone is generated first. The burst is 125 milliseconds in duration, and its amplitude is at the maximum adjusted line level as adjusted with a tone—lets say +14 DBM.

At the base station, the Guardtone Decoder recognizes the high level guardtone burst and activates a 350 millisecond function tone acceptance "Window", during which time information will be accepted by the function decoders.

At the end of 125 milliseconds, the high level guardtone burst is complete, and the 40 millisecond function tone burst is started at a level 10 DB below that of the guardtone burst—that is to say, if the guardtone level is +14 DBM, then the function tone level will be at +4 DBM, 10 DBM less than the function tone. At the base station,

the function decoder will now accept the incoming function tone, since the acceptance "Window" generated by the Guardtone Decoder is still open. Without the "Window", no function tones would be recognized, and the system would be inoperative. Since the "Window" is still open, the function is decoded and stored in a bistable multivibrator at about the 130 millisecond point, as indicated in the diagram. At approximately 160 milliseconds, the function tone turns off at the Remote Console; and at 200 milliseconds, the acceptance "Window" closes and the station is ready for another command.

Okay—lets review the function tone command. When the command is initiated at the Remote Console, the first tone, the high level guardtone is transmitted at the full adjusted line level, say +14 DBM, and its duration is 125 milliseconds. During this period of time, the Guardtone Decoder at the base station recognizes the incoming tone and starts the acceptance time "Window" generator, which allows function tone information to be accepted by the function decoders. Remember, this "Window" must be open for a function to be decoded. The guardtone completes its 125 millisecond burst; and at that point of time, the 40 millisecond function tone is initiated and generated at a level 10 DB below the guardtone. Since the acceptance "Window is still open, the appropriate function tone decoder will accept the incoming function tone and the function will be decoded and stored in a bistable multivibrator. At approximately 260 milliseconds, the function tone turns off at the Remote Console, resetting the Guardtone Decoder. This station is now ready for another function command.

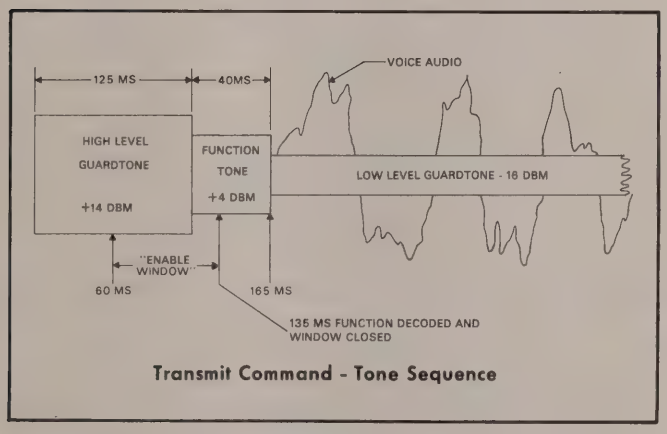


FIGURE 11.

C. TRANSMIT COMMAND SEQUENCE

Now in Figure 11 lets look at a transmit command sequence. A transmit command begins in exactly the same way that a function command does; that is, first the high level guardtone is initiated at full adjusted line level; its duration, as before, is 125 milliseconds. At the 60 millisecond point, the Guardtone Module decodes a push-to-talk command and initiates the acceptance "Window" timer; that is, it opens the "Window". Also, the base station receiver is muted, and some transmitter circuitry is activated.

At 125 milliseconds, the high level guardtone turns off at the console, and the 40 millisecond function tone 10 DB below the guardtone, turns on, commanding F1 or F2. At the 130 millisecond point, the F1 or F2 function decoder turns on the selected transmitter channel element, supplying RF drive to the transmitter. Simultaneously, the "Window" is closed by the decoder circuitry to insure against falsing of other decoders.

At 160 milliseconds, the function tone turns off at the tone console and a low level guardtone, 30 DB below rated line level, is impressed upon the line. The low level guardtone maintains the push-to-talk signal for the duration of the transmission. A notch filter in the transmitter modulator path prevents the guardtone from being heard on the air. When the transmission is ended, the low level guardtone is removed, push-to-talk is dropped out, and, after 70 milliseconds, the station is completely reset and ready for another transmission.

Lets go over that again. Lets review the tone sequence of a transmit command. First the high level guardtone burst—125 milliseconds at the rated line level. The high level guardtone is recognized at the station by the Guardtone Decoder, and, as with a function command, several operations take place immediately. The Guardtone Module decodes a push-to-talk command, and at the same time mutes the base station receiver, insuring a quiet line during the time of command. Also, the acceptance "Window" timer is started. Again, this provides the "Window" for the function decoder, during which time the decoder can operate and accept function tones. After 125 milliseconds, the high level guardtone turns off and the 40 millisecond function tone is triggered. In this case, the function tone will command either F1 or F2. At approximately 130 milliseconds - that is to say, about 6 milliseconds after the function tone is started—the transmit function decoder will turn on the selected transmitter channel element. Simultaneously, the acceptance enable "Window" is closed to prevent possible falsing of other decoders. At approximately 155 milliseconds, the function tone turns off and a low level guardtone, 30 DB below the rated line level plus voice intelligence, is impressed upon the line. The low level guardtone maintains push-to-talk during transmission. The low level guardtone is not heard on the air since a notch filter in the transmitter modulator path prevents this frequency from modulating the transmitter. Finally, when the transmission is ended, the guardtone and speech are removed fron the line; and after 70 milliseconds, the station is reset and ready for another transmission.

IV. SIMPLIFIED BLOCK DIAGRAMS

Okay—now, lets take our knowledge of the coding system that we have just gained and apply it to simplified block diagrams showing the major functions used in Base Station Tone Remote Control.

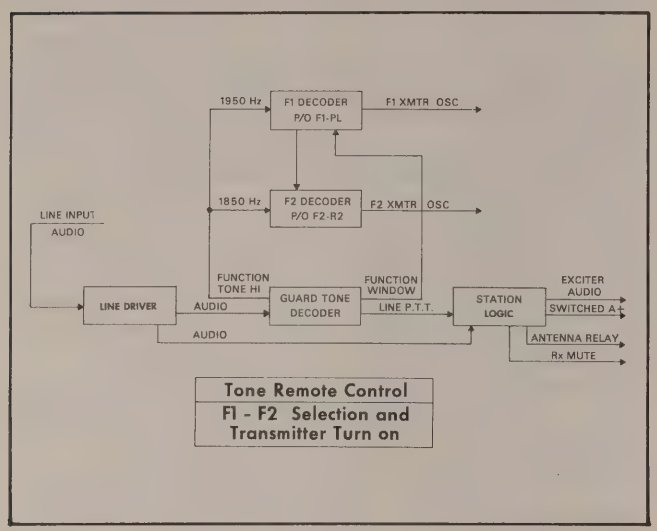


FIGURE 12.

A. F1-F2 SELECTION AND TRANSMIT

First of all—Figure 12—lets look at F1 and F2 selection and transmitter turn-on. Starting from the left hand side, we see line audio coming into the base station. The line audio is coupled to the Line Driver Module, and amplified and routed to the Station Logic and Guardtone Modules.

As we have just learned, the first tone that arrives at the remote control section is the high level guardtone. This is routed through the line driver to the Guardtone Decoder. As you can see, there are several outputs from the Guardtone Decoder. Actually, the first one that does occur is line push-to-talk and this is fed directly to the Station Logic Module, on the far right, which produces switched A+, antenna relay, and receiver mute outputs. Another output from the Guardtone Module is the function tone "high" coming off the left hand side of the block. This is routed to all the function decoders. The only decoders shown here are the F1 and F2 decoders. The third output from the Guardtone Module is the function "Window". This output is coupled to the F1 decoder and actuates the function enable stage. The function tone must arrive at the function decoders while the "Window" is "open" in order to be decoded.

After the high level guardtone turns off and the function tone is started, the function tone is routed to its appropriate decoder. Actually, it is routed to all the decoders, but is accepted only by the decoder having the proper filter circuitry for the frequency of that function tone. Looking primarily at the F1 Decoder - which is the top, or uppermost, block - we find that the 1950 Hz F1 function tone arrives at the F1 decoder input circuitry. Since the Guardtone Decoder is still supplying the function "Window", the input circuitry of the F1 decoder will recognize and decode the F1 function tone. As it is decoded, the command is stored in a bistable multivibrator - and simultaneously the F1 transmitter channel element is turned "on", providing transmitter drive.

At the time that the F1 decoder actually decoded the incoming command and turned on the transmitter channel element, the function "Window" was instantly closed - thus insuring against falsing any of the other decoders.

As soon as the function tone is complete, it, of course, ceases to exist. But is is replaced by a low level guardtone, as we have learned before. The low level guardtone is accepted by the Guardtone Decorder, and does maintain line push-to-talk information to the Station Logic Module for the duration of the transmission. As soon as the low level guardtone ceases, the station will unkey and return to a ready condition waiting for another command.

F2 selection and transmitter turn-on is precisely the same as F1, the only difference being the function tone frequency. The F2 function tone frequency is 1850 Hz.

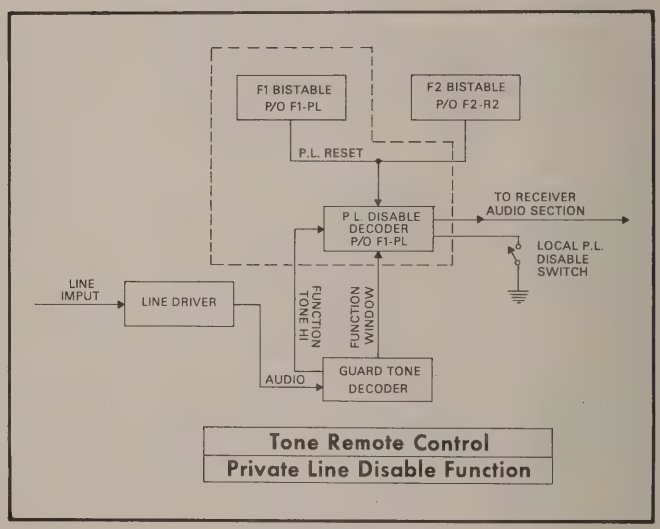


FIGURE 13.

B. "P. L." DISABLE COMMAND

Lets look at a simplified block diagram - Figure 13 - showing the operation of the "Private Line" disable function - one of the basic functions necessary with remote control base station operation.

As before, the incoming signals from the Remore Console are coupled through the Line Driver Module and then to the Guardtone Module. Of course, the command controlling "Private Line" disable is a standard two tone sequence; first the high level guardtone, and then the function tone.

The high level guardtone is decoded by the Guardtone Decoder, as before, and provides line push-to-talk outputs to the Station Logic Module. During a function command, the push-to-talk signal is necessary only to activate the receiver mute to prevent receiver audio from interfering with the command. More important, is the fact that the Guardtone Module does provide the "Window" that turns on the function enable which is routed from the F1 Module to all the function decoders.

In this case, we are concerned with the "P. L. ", or "Private Line" disable decoder, which is located at the center of the F1-PL block diagram. After the high level guardtone is completed, the function tone is initiated. The "P. L." disable tone is 2050 Hz. This signal is amplified by the Guardtone Decoder and coupled out on the function tone high lead to all of the function tone decoders, but is accepted by only the "P. L." disable decoder. Since the function enable is present at the same time that the "P. L." disable function tone arrives at the "P. L." disable decoder, the function is decoded and stored in a bistable multivibrator.

Immediately, the output of the bistable multivibrator is routed via the Local Control Module to the necessary portion of the receiver audio circuitry - in this case, the squelch switch transistor in the squelch circuitry - thereby disabling the "P. L." squelch, switching the receiver back to the carrier squelch mode, and allowing the operator to monitor the channel before a transmission.

The "P. L." disable circuitry remains in the disable mode even after the function tone is completed, and it will remain this way until a transmit command is initiated. When the dispatcher at the Remote Console commands either F1 or F2 in the case of a multiple frequency station, immediately an output from the F1 or F2 decoder is coupled back to the "P. L." disable decoder, indicated as "P. L." Reset near the top of the diagram. "P. L." Reset is coupled directly into the "P. L." disable decoder, resetting the circuit to the "P. L." mode.

This particular operation is a departure from the type of function provided by D. C. Remote Control - in which case the station was held in the "P. L." disable mode only as long as the proper line current was provided from the Remote Console, and as soon as that line current was removed from the line, the station immediately reverted back to the "P. L." squelch mode.

Now, with Tone Remote Control, the instant the command is initiated, the station switches into carrier squelch mode—that is, "P. L." disable- and remains that way without any further command by the Remote Console as long as the operator desires. However, as soon as he transmits, the system automatically reverts back to the "P. L." mode.

As indicated by the switch immediately to the right of the "P. L." disable decoder block on the diagram, this function can also be accomplished locally, at the remote base station, by the Service Technician; and, as with the remote control, the station will remain in the "P. L." disable mode until a transmit command is initiated- at which time it will revert back to the "P. L." mode.

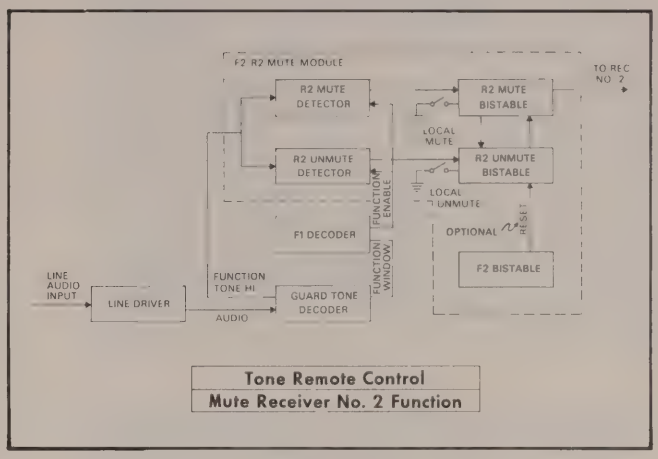


FIGURE 14.

C. MUTE RECEIVER NUMBER TWO COMMAND

Now, in Figure 14, we are looking at another basic remote control function - the mute receiver two function which allows the second base station receiver audio to be muted for extended periods of time.

As before, the tone commands are accepted by the Line Driver Module in the remote control chassis, coupled to the Guardtone Decoder. The Guardtone Decoder reacts and provides its line push-to-talk output to the Station Logic Module.

As soon as the high level guardtone is complete, the function tone is initiated, and, again, the output is coupled out of the Guardtone Decoder —as the function tone high—to the various function tone decoders. In this case, we are interested in the receiver two Mute and receiver two Un-mute Decoders which are part of the F2 - R2 Mute Module. The function tones involved here are 1650 Hz for R2 un-mute, and 1750 Hz for R2 mute.

Let us say that we are going to mute receiver two. We would route 1750 Hz from the Guardtone Decoder to the R2 mute portion of the F2 - R2 Mute Decoder. The function enable "Window" is present at the decoder at the time that the function tone arrives. Therefore, the R2 mute circuitry responds to the incoming tone and immediately the function is decoded and stored in the R2 Mute Bistable multivibrator - indicated in the upper right hand corner of the diagram. The output of the R2 Mute Bistable - is coupled

to receiver two and does mute the audio circuitry of that receiver and the function is accomplished.

To un-mute receiver two, the 1650 Hz function tone is commanded at the Remote Console. When this command is initiated, it is routed to the line Driver and Guardtone Decoders and, finally, to the R2 Un-mute Decoder. When the R2 Un-mute Decoder responds, its output is coupled to the R2 Mute Bistable — the middle block on the right side of the diagram. As this bistable responds, it resets the R2 Mute Bisable into the un-mute mode, thereby un-muting receiver two. As you can see, these two bistable multivibrators are cross-coupled so that when one switches one way, the other is switched the opposite way; and also , as indicated by the switches on the left hand side of each bistable multivibrator, this function can be accomplished locally at the base station by the Service Technician.

Now, actually, the primary purpose of the mute receiver two function is to mute receiver two for extended periods of time. This is not the case with D. C. remote control. With D. C. systems, the R2 mute circuitry automatically reverts back to the un-mute mode as soon as a transmission is commanded on the F2 frequency.

Though available, this reset action is not normally necessary with Tone Remote Control because of a very simple circuit called an Rl Priority Kit standard on all Tone Control Systems. The Rl Priority Kit consists of one transistor and two resistors. It is installed in the power supply section of the base station and provides complete priority of the R1 receiver over the R2 receiver. This feature eliminates much of the need for muting the second receiver via tone control because, as soon as the Rl frequency is received by the first receiver, it automatically mutes the second receiver during that period of the transmission. So, in many cases, the R2 mute - unmute function in tone systems will be used for muting the second receiver for extended periods of time when it is not desirable to hear the second receiver at all.

In normal operation, where the system is being used more or less continously with two frequencies, it would be more convenient for the operator to allow the Rl priority feature to mute the second receiver when the priority Rl channel is received, and to automatically revert to simultaneous stand — by on both Rl and R2 as soon as the transmission is ended.

The actual usage of this function will be determined by the customer's needs.

V. LOGIC SYMBOLS

A. INTRODUCTION

Before beginning with the remote control circuits in greater detail, let us prepare by discussing the usage and meaning of logic symbols. Logic symbols are a means of displaying on a diagram or schematic the operation and/or function of a circuit without showing the circuit componants. These symbols will be encounted on a detailed functional diagram of the D. C. Remote Control system. Therefore, in order to better understand the detailed functional diagram, an understanding of the logic symbols is needed.

Basically, three different logic symbols are encountered.

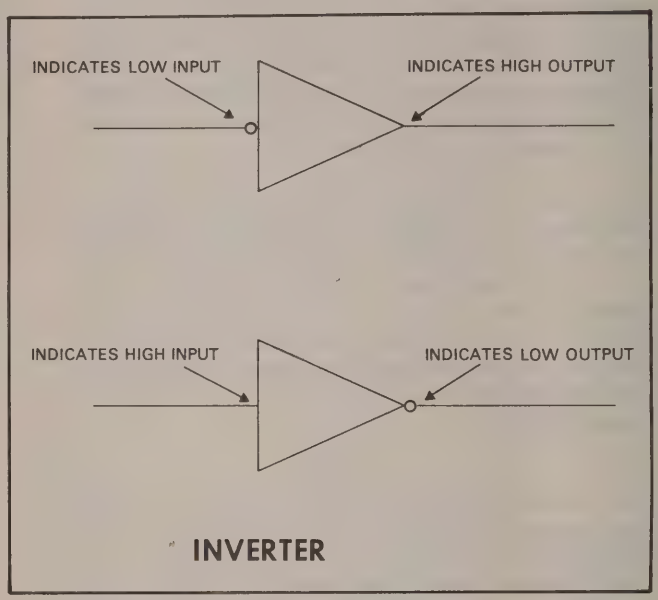


FIGURE 15.

B. INVERTER

The first symbol that will be encountered is the symbol for an inverter stage. The symbol used to represent an inverter is shown on Figure 15. The inverter stage receives an input which may be high or low, and inverts it to the opposite state. A level is referred to as a high if its potential is the greater of the two voltage conditions encountered. As previously mentioned, the inverter may have either a high or a low input, and its output will be the opposite state. The inverter may or may not produce an amplified output. The same symbol may also be used for an amplifier stage.

Whenever a level is considered to be a low, it is indicated by means of a small circle in series with the lead connected to the stage. The inverter is primarily used to produce an input to a succeeding stage of the proper level — that is, a high or a low — as needed by that stage.

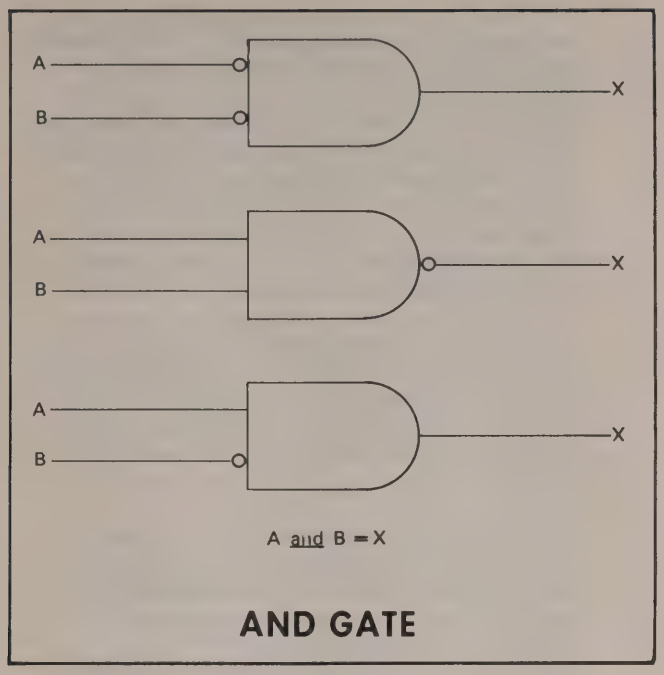


FIGURE 16.

C. AND GATE

A second symbol that is encountered on the functional diagram is that of an And Gate, as seen in Figure 16. An And Gate is a circuit with one or more inputs that requires all inputs be of the correct level in order to achieve an output. That is, with two inputs labelled A and B, both input A and input B must be of the proper level to obtain the desired output fron the And Gate. Inputs may be either a high level or a low level input, and the output may be a high level or a low level, as needed. In the usual usage of an And Gate, all inputs will be low or all inputs will be high in order to activate the And Gate. However, in certain circumstances there could be a possibility of having one input high while at the same time the other, or second, input is low in order to achieve the desired output from the And Gate. As with the inverter, a low level condition will be indicated by a small circle in series with the lead either on the input or the output of the And Gate symbol.

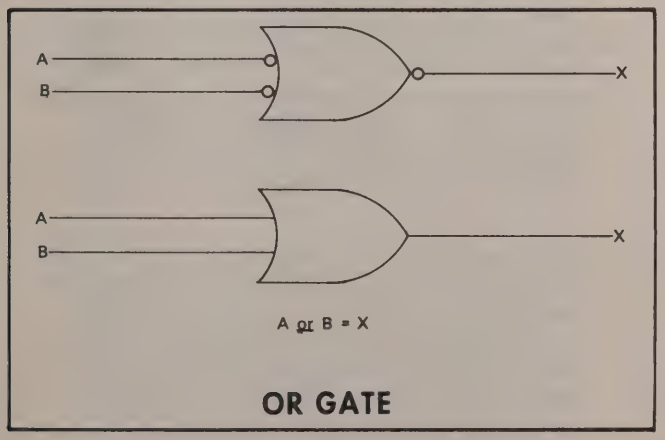


FIGURE 17.

D. OR GATE

Figure 17 A third logic symbol encountered on the detailed function diagram is that of an Or Gate. An Or Gate has two or more inputs and a single output, the same as the And Gate. However, where the And Gate required that an input at A and B be present, the Or Gate merely requires that an input of the correct level be present at either input A or input B in order to produce the desired or active state in the output. Again, the inputs and outputs may be either high or low as conditions require.

The three logic symbols just mentioned, the Inverter, the And Gate, and the Or Gate, are the only ones used on the detailed functional diagram. Other circuits — indicated by rectangles — such as transistor switches, bistables, and Schmitt triggers, should also be understood for complete comprehension of system operation from the detailed functional diagram. The circuits just mentioned will not be discussed at this time. However, additional information is available in your Study Guide.

VI. DETAILED FUNCTIONAL BLOCK DIAGRAM ANALYSIS

A. INTRODUCTION

Let's take a more detailed look at the Tone Remote system by using the Detailed Functional Block Diagram. This diagram is located just in front of the schematics in your Study Guide.

You will note from looking at this diagram that all the blocks are identified by a letter in a circle. We will use these letters throughout the block diagram description to help you locate the modules being analyzed. Also, These letters are used to identify the routing of intercabling.

Notice on your diagram the cabling on each module. Every lead is identified with a letter followed by a number — such as G-15. This indicates that wire is going to pin 15 on module G. Module G is the $\overline{\text{F1-PL}}$ Module. This system makes the Functional Block Diagram an excellent tool for troubleshooting in the field.

B. TRANSMIT F1

First we will trace a transmit F1 command through the Detailed Functional Block Diagram.

1. TRANSMIT AUDIO

To begin, the command is sent from the Tone Remote Console at the dispatch point via the wire lines, telephone lines or other carrier to the remote base station. The Lines are connected to the base station remote control chasis and are routed first to the Line Driver Module.

This is "H" on your Detailed Functional

Block Diagram. The line audio is tied to pins 16 and 17 of the module, coupled in to the primary of the line transformer, and out through the tertiary winding at the bottom of the transformer. As you can see, there are two output paths from this secondary winding.

The first path which is the transmitter audio signal, going to the right, it routed via the exciter-speaker amplifier, Q9, out pin 19 to the Station Logic Module, block L, where it is further amplified by the paraphase amplifier, Q1, and by the audio amplifier, Q2. This audio signal is then coupled out of the Station Logic Module to the transmit notch filter located on the F1-P1 Decoder Module, block G.

The notch filter removes the 2175 Hz guardtone component from the transmitter audio path. Upon leaving the filter, this audio signal is connected to the exciter audio section and is used to modulate the transmitter.

2. GUARDTONE AUDIO PERIOD

The other audio path at the line transformer tertiary winding, goes off to the left via jumper JU4 and out of the Line Driver Module on pin 9. This path is to the Guardtone Decoder and is used ultimately to key the transmitter.

Remember, now! We are talking about a transmit command; and a transmit command is the reception of a 125 millisecond high level guardtone—followed by a 35 millisecond function tone—which in this case will be the F1 function tone - and finally, by a low level guardtone of a length determined, of course, by the length of the transmission.

At the Guardtone Decoder—block E on your diagram, the first part of the transmit command, the high level guardtone, is connected to pin 9 on the Guardtone Decoder. It is coupled to the 2165 Hz pre-filter tank circuit - which provides selectivity and protection against undesired signals and noise - through the tank circuit, and amplified by four stages of amplification. The output amplifier, Q4, is the Reed Driver which drives the 2175 Hz "Vibrasponder" reed, and also supplies an input to the Line AGC Detector, Q10.

The line AGC circuit has a very fast attack time, and upon receipt of the strong high level guardtone, immediately adjusts the level input to Q2 in the amplifier string to prevent overdrive and clipping to the reed. The threshold point of the line AGC is -25 DBM on the line at the base station. This level, then, is the minimum operating level of the system, being more than 30 DB below normal operating level.

The reed driver, Q4, also supplies an input to the activity checker circuit. This circuit inhibits the D.C. isolator, Q12, and the gated AGC detector Q7, until audio signals are present on the line. A few milliseconds after the high level guardtone is received, Q18 - in the activity checker - is turned off, changing the low inhibit output to a high, readying the $\overline{\text{D.C.}}$ isolator for an input from the Guardtone Detector, Q11 and "Gating" the Gated AGC to an active condition.

The high level guardtone from the reed driver, Q4, is applied to and coupled through 2175 Hz "Vibrasponder" reed. This signal is further amplified by two amplifiers, Q5 and Q6, and then applied to the Guardtone Detector, Q11.

An output from amplifier,Q5 is coupled to the Gated AGC Detector—and AGC isolator, Q8, ultimately controlling the attenuator stage, Q9, which is also common to the line AGC. Though the Gated AGC is activated at this time, no noticeable action takes place because of the very slow attack time of this circuit. Gated AGC action takes place later in the time sequence.

The audio input from Q6 drives the Guardtone Detector, Q11, which produces a high D.C. output. Remember, the activity checker inhibit has been removed from this point. The high from Q11 drives the D.C. isolator, Q12, producing a high output, which, in turn, drives the Push-to-Talk Switch, Q13, producing a low output. Elapsed time to this point is approximately 50 milliseconds.

The line push-to-talk output has two basic purposes.

The first is to drive the push-to-talk circuitry in the Station Logic Module. The line push-to-talk low received from the Guardtone Decoder Module is coupled via pin 14 of the Station Logic Module to the push-to-talk Or Gate #1 and to the Local Mike Inhibit Switch, Q3. These circuits are located on the left hand side of the Station Logic Module block diagram. Both inputs to the Local Mike Inhibit Switch and Gate are satisfied with the presence of the push-to-talk low input. The other input, being the exciter ground, is always present. Q3 switches, and its output swings high disabling the local microphone audio circuit during line transmissions.

The push-to-talk low also activates the push-to-talk Or Gate #1. Its output switches low and is coupled directly to the push-to-talk Or Gate #2 which also switches low. This low is coupled to the push-to-talk inverter stage, Q4, where it is inverted and fed to the remaining circuitry as a high.

The high output from the push-to-talk inverter, Q4, is coupled to two stages. The first is the Antenna Relay and Receiver Mute Switch, Q6, which switches and activates the antenna relay and the audio mute circuitry located in the receiver as well as the Line Driver Switch located on the Line Driver Module.

The other circuit driven by the push-to-talk inverter, Q4, which is the Switched A+ Driver, Q5, located in the upper center of the diagram. Q5 is a two input And Gate requiring a high input from both the push-to-talk inverter, Q5, which is already present, and the transmit key inhibit line.

The transmitter key inhibit input, when used, is from the time-out timer circuit and would normally be a high output. The exception is in the timed-out condition, during which time the transmitter key inhibit line would be a low, thus inhibiting the switched A+ Driver, Q5.

With the two high inputs present, the Switched A+ Driver, Q5, switches to a low output — which is coupled directly to the A+ Switch stage, Q7, another And Gate.

This gate requires one low and one high input to provide a Switched A+ output high. The high input is satisfied by coupling A+ from the power supply, via pin 12 of the Station Logic Module, directly to the input in the A+ Switch circuit, Q7. The other input is a low, from the switched A+ driver. These two inputs satisfy the And Gate, and the circuit output switches high. This output, called Switched A+, is coupled out of the module, and is used to activate several different functions throughout the base station system — including the transmitter exciter and portions of the power supply.

The A+ Switch circuitry and the Antenna Relay and Mute Switch circuitry and so designed that though they are activated simultaneously, the Antenna Relay is closed approximately 35 milliseconds before the A+ Switch activates, thus allowing the antenna relay contacts to switch cold - that is, without any RF power on the contacts - thereby extending the life of the relay.

The second purpose of the line push-to-talk low is to further actuate the Guardtone Decoder. First, the push-to-talk signal — turns off the Bootstrap stage, Q15 — on the center right — increasing the gain of the guardtone amplifier, Q5, by 30 DB, preparing it for the appearance of the low level guardtone which is 30 DB below the high level guardtone. Secondly, it triggers the 350 millisecond function tone "Window" generator — at the lower right. This, in turn holds, for 350 milliseconds, the Decoder Bias Switch, Q17, and the Pre-filter Switch, Q16.

The Pre-filter Switch, Q16, is turned off removing the selectivity of the 2165 Hz pre-filter network — on the upper left — so that all function tone frequencies may be coupled to and amplified by the amplifiers Q1 through Q4 during the 350 millisecond "Window" period.

The Decoder Bias Switch, Q17 — at the lower right — is turned off and provides a high output during the 350 millisecond "Window" period. This high output is coupled out of the module on pin 15 to the F1 Decoder Module.

The Decoder Bias Switch high from the Guardtone Decoder Module is coupled into the F1 Control Module on pin 15, and is connected directly to the function enable stage Q7. This high input activates the function enable output and is used to activate all of the tone detector stages throughout the Tone Remote Control system. The function enable stage, Q7, is activated for only a short period of time. Therefore, the function tone must be present at the tone decoder during that period of time that the function enable is present in order for it to be decoded.

After the function enable stage, Q7, loses its input from the Guardtone Decoder, it turns off, and its output goes high, thus disabling all tone detectors throughout the Tone Control system, and removing any possibility of falsing until a proper command sequence is once again originated at the Tone Remote Console.

3. FUNCTION TONE PERIOD.

At the end of the high level guardtone, 125 milliseconds after the start of the sequence, the 40 millisecond function tone begins. The level of the function tone is 10 DB lower than the Guardtone. No noticeable AGC action takes place during the function tone because of the very slow release time of the line AGC circuit and the short duration of the function tone. The line AGC level remains fixed at the point set during the period of high level guardtone.

The function tone is amplified by amplifiers Q1 to Q4 of the Guardtone Decoder and coupled to all of the various tone decoders via pin 11 of the board, and is known as the "Function Tone High".

Remember, that in order for the function tone to be useable, the pre-filter tuned circuit has been switched out by Pre-filter Switch, Q16; and that the Decoder Bias Switch, Q17, is generating an output necessary to produce an "Enable" for the decoders during — and only during — the period of the function tone "Window".

The F1 function tone high is coupled to pin 14 of the F1 Control Module, labelled G on

your Detailed Functional Block Diagram. The F1 function tone is coupled directly to the function tone amplifier on that module. The amplified output is coupled to two tuned circuits, the first being the F1 tuned circuit — 1950 Hz — and the second, directly below, is the "P.L." disable circuit - 2050 Hz.

The selectivity of the 1950 Hz tank circuit allows the F1 function tone to pass and to be applied to the detector stage immediately following.

We know that the enable low is applied to the F1 Detector stage, making it operational. The amplified F1 function tone is detected, transformed into a D.C. output and applied as a trigger to the F1 Bistable — in the upper center.

Before the F1 Bistable multivibrator can operate, it must receive a switched 8.8 volt enabling input from the Line Control Priority Gate, Q5 and Q6, in the upper right hand corner of the F1 Control Module. The Line Control Priority Gate provides a switched 8.8 volt output only when both the 8.8 volt input from the Local Control Module and the switched A+ input from the Station Logic Module are applied to the circuit. The switched 8.8 volt output from this gate is applied to the F1 Bistable multivibrator; and via pin 9 of the F1 Control Module, it is applied to the F2 Bistable multivibrator located on the F2 Control Module.

With the switched 8.8 volt enabling signal, the F1 Bistable multivibrator switches applying a ground to the F1 channel element, allowing that circuit to operate, providing drive for the transmitter exciter.

4. LOW LEVEL GUARDTONE PERIOD.

The base station transmitter is now on the air, and remains in that condition for as long as push-to-talk is maintained. Since this is a transmit command, a low level guardtone immediately follows the function tone. Its purpose is to maintain push-to-talk during the length of the transmission, and its level is 30 DB below that of the initial high level guardtone.

Looking back at the guardtone block, we know that the gain of amplifier Q5 has already been increased 30 DB by the Bootstrap stage, Q15, readying it for the low level guardtone. The Gated AGC circuit, which was triggered initially during the first 100 milliseconds, now comes into use due to its very slow pickup or attack time. The line AGC is no longer used because the low level guardtone is below its threshold point of -25 DBM.

The Gated AGC is used to maintain only the the low level guardtone level. The circuit will react only to the guardtone frequency because its feedback control loop includes the narrow selectivity of the 2175 Hz "Vibrasponder" reed.

The Gated AGC threshold point is -55 DBM on the line. This figure may be related to the fact that the low level guardtone is 30 DB below the high level guardtone, and that the line AGC threshold is -25 DBM, or 30 DB above the Gated AGC threshold.

So, we can see that the two AGC circuits are designed to maintain a proper drive level to the guardtone "Vibrasponder" reed and to the Guardtone Detector under the widely separate conditions of high and low level guardtone, and with up to 30 DB of line loss from console to base station.

5. END OF TRANSMIT.

Now, referring to the guardtone block, lets see what happens upon ending the transmit command at the dispatch point. The operator removes his hand from the microphone key, terminating the low level guardtone from the console. Tone is no longer routed via the Line Driver Module to the Guardtone Module. The activity checker circuit recognizes the loss of tone and its output goes low. This is coupled to the input of the D.C. isolator, Q12, turning it off, which, in turn, shuts off the Push-to-Talk Switch, Q13 removing the push-to-talk signal from the system.

As the Push-to-Talk Switch turns off, a high is coupled to the Reed Quench circuit, Q14 - near the center of the diagram — which in turn, "quenches" or grounds the reed for about 100 milliseconds, thus allowing a very rapid system turn-off. This quenching action is necessary to prevent a normally slow decay of reed output due to a high inherent "Q" and mass of the reed.

When push-to-talk is removed from the input to the station Logic Module and that circuit relazes, its outputs are turned off. As switched A+ is lost, the Antenna Relay and Mute Switch turns off and the local mike inhibit is no longer produced; thus, the transmitter is turned off.

At the loss of switched A+ from the Station Logic Module, that signal is simultaneously removed from the input of the Line Control Priority Gate in the F1-PL Module thus removing the switched 8.8 volt output from that circuit. The removal of this output, then, will turn off the F1 Bistable multivibrator, thus removing the channel element ground and completing the turn-off of the base station transmitter.

6. REVIEW.

A quick review of the F1 transmit command will show us that four control modules are involved in decoding that command. First, the Line Driver Module

which couples the control circuitry to the telephone line and routes the audio from the control line to the various points throughout the control system. Secondly, the Guardtone Module which decodes the initial portions of the transmit command and provides a push-to-talk output and a function tone "Window" during which time the function command will be allowed. It also adjusts the audio levels into the Guardtone Decoder via its AGC circuits. Third, the Station Logic Module which accepts the push-to-talk input from the Guardtone Decoder generates the switched A+ output, the antenna relay and receiver mute outputs, and the local microphone inhibit output, and receives audio signals from the Line Driver Module, amplifying and preparing them before applying them to the exciter circuitry. And, finally, the fourth module involved in the F1 transmit command—the F1-PL Control Module which accepts the 40 millisecond function tone burst as well as the Decoder Bias Switch output from the Guardtone Decoder, and produces the function tone enable which is applied to all of the function tone decoders - not only the F1 decoder. Upon receipt of the proper signals, the F1 control circuitry then decodes that function tone and provides an F1 oscillator ground, thus providing drive for the transmitter exciter. That, in co-ordination with the outputs of the Station Logic Module, turns on the transmitter which is maintained on the air until loss of low level guardtone from the Remote Console.

C. TRANSMIT F2

Okay - so much for F1! Now lets look further into the system and see what it takes to transmit on F2.

Tracing an F2 transmit command is very much the same as tracing the F1 command. Let us say the F2 transmit command is initiated at the Remote Console. It is identical to the F1 command, except for the frequency of the function tone which is 1850 Hz.

The Guardtone Decoder Module is operated as before, and all of its circuit operations are exactly the same as in an F1 command. The F2 function tone, as before, is routed via pin 11 in the Guardtone Decoder as the function tone high output to all of the Function Tone Decoder Modules. However, there is only one 1850 Hz tone decoder, and that is on the F2 Control Module. Only that decoder will respond to the F2 command signal.

Looking at the F2 Control Module, block F on your Detailed Functional Block Diagram, we can see that the function tone high is routed to pin 11 of that module in the upper left, and applied to the function tone amplifier, Q4. The amplified signal is applied to the 1850 Hz tuned circuit and then to the F2 detector stage, Q1.

As before, the function enable must be applied to the detector before that circuit is operational. As in the F1 command, that enable "Window" is provided by the enable stage of F1 Control Module and coupled to the F2 Control Module, pin 13, on the left side of the block. It is applied to Q1, the F1 detector stage, making it operational and allowing the 1850 Hz F2 command signal to be detected and applied as a trigger to the F2 Bistable stage, Q2 and Q3.

As with the F1 Bistable circuitry, the F2 Bistable must also receive a switched 8.8 volt signal before it can switch. The switched 8.8 volt signal arrives at the F2 module via pin 8 from the F1 Control Module, Line Control Priority Gate. It is applied to the F2 Bistable, making it operational. The F2 Bistable switches and provides the F2 channel element ground on pin 2 at the top center of the block.

That output, in conjunction with the outputs of the Station Logic Module, will put the transmitter on the air in the F2 mode. And at the end of the transmission, the F2 Bistable circuit will be returned to its off mode upon loss of the switched 8.8 volt signal.

D. FUNCTION COMMANDS.

Okay, for the time being, so much for transmit commands. Now lets take a look at some function commands. Remember, now, a function command, as with a transmit command, consists of a high level guardtone burst, 125 milliseconds, followed by the 40 millisecond function tone burst. However, unlike the transmit command, there is no low level guardtone following the function tone burst. After the function tone burst, the command ceases. Normally, at the end of a function command, the function is stored in a bistable decoder until another command changes the condition of that decoder.

1. PL DISABLE FUNCTION.

a. PL. DISABLE.

The first function command that we will look at will be the "P.L." disable function. The tone frequency for this function is 2050 Hz.

When the first part of the command is sent—that is, the high level guardtone—it activates the Guardtone Module and all of the circuits operate precisely as in a transmit command, including the push-to-talk output from the Line Push-To-Talk Switch, Q13. However, the transmitter is not on the air since there is no channel element drive. So, after the high level guardtone, the 2050 Hz "P.L." disable function tone is generated. This is routed through the Guardtone

Decoder Module and, as with all function tones, it is coupled to all of the tone decoder modules. Due to the selectivity of the decoder circuit, the "P.L." disable function tone will be accepted by only the "P.L." disable decoder which is located in the F1-PL Control Module, block G on your Detailed Functional Block Diagram.

Looking first at the F1-PL Decoder, we see the "P.L." Disable function tone coupled into the F1-Pl Module on the pin 14, the function tone high input — on the upper left — amplified by the function tone amplifier, Q1, and coupled to the 2050 Hz tuned circuit, through the tuned circuit to the "P.L." disable detector. The enable "Window", which is present during the period of the function tone transmission, allows the "P.L." disable detector to operate. The detector produces an output which triggers the "P.L." disable bistable, causing it to switch and provide a low output to pin 21 of the module at the center. It should be noted here that the switched 8.8 volt signal necessary for operation of the F1 and F2 transmit bistale multivibrators is not necessary for "P.L." disable operation nor for any of the function decoders. This command is stored in the "P.L." disable multivibrator; and the circuit remains in the decoded condition, keeping the receiver audio circuitry in the carrier squelch mode, allowing the operator to monitor his channel before transmitting.

b. P.L. ENABLE

The system will remain in the "P.L." disable mode until the dispatcher sends a transmit command — either F1 or F2. Lets look at the condition of the circuitry when the dispatcher commands F1 transmit.

As soon as the command is sent and decoded by the F1 decoder circuitry in the F1-Pl Control Module, the F1 Bistable circuit will switch. The output from the right hand side of that circuit, Q4, is a low and is coupled normally to pin 3 of that module and provides a channel element ground. However, in a "Private Line" base station, that low is also coupled back to the "P.L." disable bistable circuitry, and is coupled via a diode to the left hand side of the bistable as seen in the center of the diagram. This low from the F1 Bistable will reset the "P.L." disable bistable and revert the receiver back to the "Private Line" mode. This action takes place upon either an F1 command or an F2 command.

It might be noted at this time that the method of "P.L." disable just described is some what of a departure from the D.C. Remote Control system presently in use whereby a "P.L." disable command only momentarily disables receiver "P.L.". This method of operation allows the operator to monitor his channel in a carrier squelch mode for only as long as the control button is depressed on the remote console. As we now know, a tone system is normally set up so that as soon as "P.L." disable is commanded, the receiver is put into the carrier squelch mode and left that way until a transmit command is initiated by the dispatcher.

2. MUTE RECEIVER TWO COMMAND

a. MUTE

The R2 mute function decoder is located on the F2-R2 Module, block F on your Detailed Functional Block diagram. Looking at the diagram we can see that the circuitry is made up of two complete decoders, each with a tuned circuit, a detector stage and a bistable multivibrator. Let's look into this diagram and see just how these stages are used to control the R2 mute function.

When the dispatcher desires to mute his second receiver, he presses the mute R2 pushbutton on the Tone Remote Console, initiating the mute R2 command, which is the high level guardtone followed by a 1750 Hz function tone burst. These tones, of course, are coupled via the line driver and the Guardtone Decoder Module and decoded by that module in the manner previously described. The amplified 1750 Hz mute R2 function tone is coupled from the guardtone Module via pin 11 as the function tone high, to pin 11 on the F2 Control Module, to the function tone amplifier, Q4. The R2 mute function tone is coupled to the 1750 Hz tuned circuit and passed through it to the input of the R2 Mute Detector Stage, Q5, which has already received the enable signal. It is detected and the output of Q5 is then coupled to the R2 Mute Bistable, Q6 and Q7, causing that stage to switch, storing the command. The output from the R2 Mute Bistable, a low is coupled out on the R2 mute line, Pin 7 of the F2-R2 Mute Module and coupled to the second receiver, muting its audio circuitry.

The system remains in this mode; that is, with the receiver number two muted, until commanded otherwise.

This decoder circuitry has several different options as to the manner in which is may be used. The most common manner is simply the use of cross coupled bistable multivibrators as shown on the diagram.

b. UNMUTE.

When used in this manner, receiver number two may be unmuted by simply commanding R2 Unmute at the Tone Remote Console. This function tone is routed via the function tone high into the F2-R2 Mute Module via the function tone amplifier to the R2 Unmute Decoder Circuitry. That is the circuit on the lowest portion of the diagram. The 1650 Hz function tone is decoded and coupled to the R2 Unmute Detector, Q8, triggering the R2 Unmute Bistable, coupling a low output, from Q10 on the right side of that bistable to Q6 on the R2 Mute Bistable directly above, thus resetting that circuit and unmuting the R2 receiver.

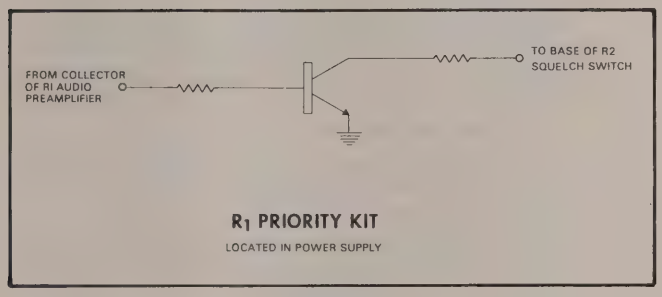


FIGURE 18.

c. R1 PRIORITY KIT

Remember now that a very simple F1 Priority Circuit is standard for these systems to provide automatic R2 Mute any time an R1 carrier is present.

The circuit is as shown in figure 15. When an R1 signal is present, a positive D.C. signal from the R1 audio amplifier collector, is coupled to the base of the NPN R1 priority stage, turning it on. This applies a low to the base of the receiver two squelch switch, turning off that receiver's audio circuits for the duration of the receiver one message.

Though the F2-R2 Mute Module may be operated in a variety of ways, its basic purpose is to mute the second receiver for extended periods of time. Momentary R2 mute is easily and conveniently handled by the R1 Priority Kit. The F2-R2 Mute Control Module also contains the second receiver controls, as indicated on the block diagram in the upper right hand corner; that is, the second receiver squelch control and audio line level control. These are screw driver adjustments from the front of the control module. The module also contains front panel mute and unmute switches which allow a Service Technician Local Control.

3. OPTIONS DECODER COMMAND.

a. INTRODUCTION

This module may be used for one of three standard options. Two of these options are shown on your Functional Block Diagram in block D in the lower left hand corner. As you can see, the block is divided into two sections. The basic decoder circuitry in each of these sections is identical. However, the usage of each is different.

The upper block is for "Private Line" control. The Options Decoder, used in this manner, allows the operator at the Remote Console to select either a carrier squelch or a "Private Line" squelch mode of operation for his base station receiver; and, upon selecting, it sets the receiver into that mode for an extended period.

The same decoder, as indicated by the lower of the two sections in block D of the diagram, is used for carrier squelch control. The decoder in this mode, then, may be used to adjust the carrier squelch circuitry of the receiver into one of two predetermined settings; that is, either tight squelch or threshold squelch. Normally, a system would be operated at threshold squelch. However, in situations of high density traffic and squelch breakage on weak signals due to distant stations or intermodulation, the operator may select tight squelch, thereby allowing only stronger signals to operate his receiver.

The third option, which is not shown here, is the Repeater Control Module. Again, the circuitry is identical - just the usage is different. This module allows for remote set up and knock down of a repeater station.

Looking at the circuitry in block D, we can see that the decoder itself is made up of a pair of cross-coupled bistable multivibrators, each preceeded by a tone decoder circuit. The tone frequencies involved are 1550 Hz and 1450 Hz. And these frequencies are identical for all three options so the same circuitry is used in every case.

b. SQUELCH CONTROL COMMAND - MAX. SQUELCH.

Let's take a closer look at the squelch control option to see just how the circuitry

operates. When a command using the 1550 Hz function tone is transmitted, it is coupled through the 1500 Hz tuned circuit to the detector stage, Q2, which triggers the Operate Maximum Squelch Bistable, Q3 and Q4, on.

A low coupled from Q4 to Q6, in turn, causes the Operate Threshold Squelch Bistable to turn off; and in doing so, a low output from Q6, via jumper JU2, turns off the attenuator amplifier, Q8, which removes any attenuation from the noise squelch signal coming from the receiver via pin 19 at the lower right of the module.

Receiver noise, then, is coupled, unattenuated, into the amplifier stage, Q9 and out of the module on pin 18 via jumper JU4, back into the noise squelch circuitry in the receiver. Thus, the receiver carrier squelch operates in the maximum condition.

c. SQUELCH CONTROL COMMAND - THRESHOLD SQUELCH.

To operate at threshold or a condition determined by the squelch control on the module which is located in the lower right hand corner, the operator sends the 1450 H Hz function tone. This tone is decoded and triggers the Operate Threshold Bistable, Q6 and Q7. This, of course, resets the Operate Maximum Squelch Bistable directly above. However, the output on the left hand side of the Operate Threshold Bistable, Q6, swings high and this signal, coupled to the attenuator amplifier via jumber JU2, causes it to turn on, grounding the Options Squelch Control. The fact that the control is now grounded attenuates the noise input signal from the base station receiver by an amount determined by the position of the squelch control. The remaining noise signal is coupled to the amplifier, Q9 and then fed back to the receiver noise squelch circuitry which operates at the sensitivity determined by the noise input, normally at threshold setting. Other uses of the Options Decoder utilize the same circuitry and the same function tone frequencies. The only difference from the Squelch Control option and the other two optional uses is the manner in which these decoders are tied into the system. The squelch control circuitry , that is the attenuator amplifier and the amplifier stages, of course, are not used in "P.L." control or repeater control.

4. WILD CARD DECODER COMMAND.

The "Wild Card" Control Module, block B, in the far lower left hand corner on your Detailed Functional Block Diagram provides four tone activated control circuits to operate distantly located functions. As the name implies, the "Wild Card" Control Module may be used to provide remote control for a multitude of functions. These applications could include a manual override for tower light control, switching of battery charging and equalizing equipment, antenna selection, operations of siren or public address equipment, remote transfer of lines or, perhaps, even test running of emergency power sources. Each individual circuit, when operated, provides a ground for a 100 milliamperes circuit. Or, it may operate a relay in the model TLN 4151 Relay Kit which is available separately for installation on the module. When using the relay kit, contacts for higher currents and complete isolation of the switched circuit from module is possible.

Operation of the decoder circuitry within the "Wild Card" Module is identical to that of the other function modules already described. Looking at the "Wild Card" Control Module Block, we can see that there are four complete sets of function decoders, each with the selectivity of its own tuned circuit. Four individual tones are used and these tones range from 1350 Hz on the high side, down to 1250 Hz, 1150 Hz and finally, 1050 Hz on the low side. We can also see that these decoders are paired; that is to say, the 1350 Hz and the 1250 Hz decoders are paired together and the bistable portions of these decoders are cross-coupled; as are the 1150 Hz and the 1051 Hz decoders. Thus, when one circuit is commanded and its bistable decoder switches, the other half of the pair is reset and vice versa.

Looking at the top pair of decoders and assuming that a 1350 Hz function tone is used in the command burst, we find that the upper decoder will react. The bistable circuit, Q3 and Q4, will switch. A low output will be coupled out of Q4 on the left hand side to the external circuit, or, it will be coupled into the relay coil of the Optional Relay Kit causing that relay to switch and its contacts to change state. The circuit will remain in this condition and the command will be stored in the bistable, until the function tone of the associated decoder is commanded at the Tone Remote Console.

When the other command guardtone plus the 1250 Hz function tone is decoded, the second bistable, that is, Q6 and Q7, will be triggered, providing a low output from Q7 to the external circuit. An output from Q7 is also coupled to the first bistable, Q3 and Q4, causing it to reset and its output to relax and go high. If an Optional Relay Kit is used, that relay will turn off and its contacts will switch back to the normally closed condition.

Operation of the lower pair of decoders is exactly the same as the upper pair.

Note that each decoder has a mechanical switch tied to the bistable circuitry. These switches are located on the front panel of the module and are accessible by the Service Technician for local switching of the "Wild Card" circuitry.

E. LOCAL CONTROL TRANSMIT.

1. TRANSMIT COMMAND.

Local control transmit is accomplished by moving the Transmit Switch, located in the Local Control Module block K in the very upper right hand corner of the Detailed Functional Block Diagram, to the left into the transmit position. This applies a ground from pin 1 of that module through the now closed switch, out of the module on pin 14 and routes it to the F1-PL Control Module, pin 24.

The local push-to-talk ground is coupled to the Line Transmit Priority Gate on the far right. The Line Transmit Priority Gate responds by supplying a low at its output to pin 23 of the F1-Pl Module. This low will be used for the local F1 or F2 ground.

Another output from the line transmit Priority Gate is coupled to the Line Control Priority Gate, directly above. This output activates the line control priority gate circuitry, Q5 and Q6 and allows it to supply the switched 8.8 volt buss necessary to operate either the F1 or F2 Bistable circuitry.

The local F1-F2 ground is routed from pin 23 of the F1-PL Control Module to pin 20 on the F2 Control Module, block F on your Detailed Functional Block Diagram, from pin 20 of that block to the Local F1-F2 Control Switch located on the front panel of that module. The position of this switch will determine what frequency the base station will transmit on during local control transmit.

Let us say that the switch is in the F2 position. The local F1-F2 ground from the F1-PL Module is then routed through the F2 contacts and as indicated to the F2 detector stage, Q1. This ground will trigger the F2 Bistable circuitry, turning on the F2 channel element. Remember that we do have the switched 8.8 volt buss generated from the F1-PL Control Module and that this voltage is necessary to operate either the F2 or F1 Bistable circuitry. The base station transmitter is now transmitting by local control on F2. Local F1 operation is identical except that the local F1-F2 ground is to the F1-PL Control Module circuitry, turning on the F1 channel element.

While the local push-to-talk ground from the Local Control Module was being routed to the F1-Pl Control Module and subsequently to the F2 Control Module, that local push-to-talk signal was also routed to pin 10 of the Station Logic Module, activating it as previously described and providing all of the various functions necessary to activate the base station transmitter circuitry with the exception of channel element control.

2. LINE TRANSMIT PRIORITY.

Now that we have seen the operation of local transmit control, let's refer again to the F1-PL Control Module, block G of the functional diagram and look at the line transmit priority gate circuitry. As the name implies, line transmit commands have priority over local transmit commands. This is accomplished by coupling the line push-to-talk signal from the Guardtone Decoder Module to pin 19 of the F1-PL Control Module and into the Line Transmit Control Priority Gate. When this line push-to-talk signal is received at that circuit, it will inhibit the local F1-F2 ground control circuitry. By inhibiting this circuit, the local F1-F2 ground is turned off, removing that necessary signal for local control transmit commands. Thus, if a local control transmission were in progress and a line transmission were initiated by the remote console, the instant that the control circuitry in the Guardtone Decoder Module— provided a line push-to-talk output, the local F1-F2 ground being used at that moment would be turned off, thus removing control of the base station transmitter from local control and the tone commands would continue to be decoded by the system and operate the base station transmitter in the mode determined by the line commands— either F1 or F2. Thus, line transmit control commands have priority over local control transmit commands.

VII. SERVICING TECHNIQUES USING TEK-38 BASE STATION MODULE SERVICING ADAPTER

The TEK-38 Base Station Module Servicing Adapter in figure 19 provides the Service Technician a convenient means of trouble-shooting and repairing any Base Station Remote Control Circuit Module away from the station site. This feature eliminates the need for the base station as a source of power and actuating signals for module servicing.

The TEK-38 is easy to use and will accommodate all control modules used in Upright Base and Compa Stations from low band through 450 MHz and into 960 MHz. The

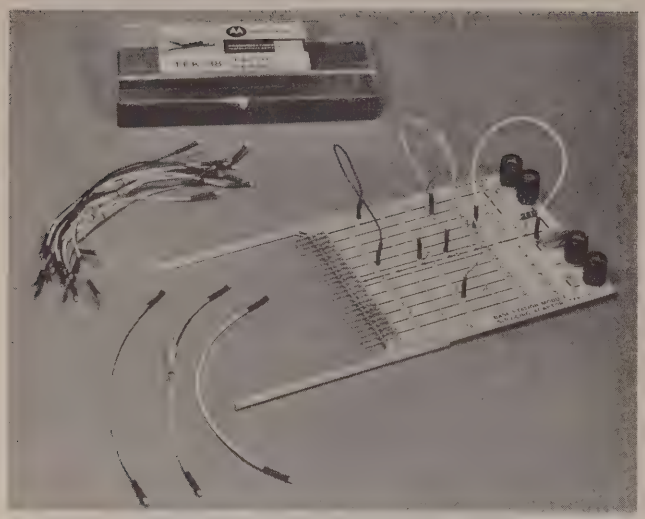


FIGURE 19. THE TEK-38 BASE STATION MODULE SERVICING ADAPTER AND PATCH LEADS.

circuit module is simply "plugged in" to the 24 pin male plug. Figure 20. Then, by using the "Out of Circuit Servicing Chart" located in each Base Station Module Manual Section, the connections necessary to operate the module are noted.

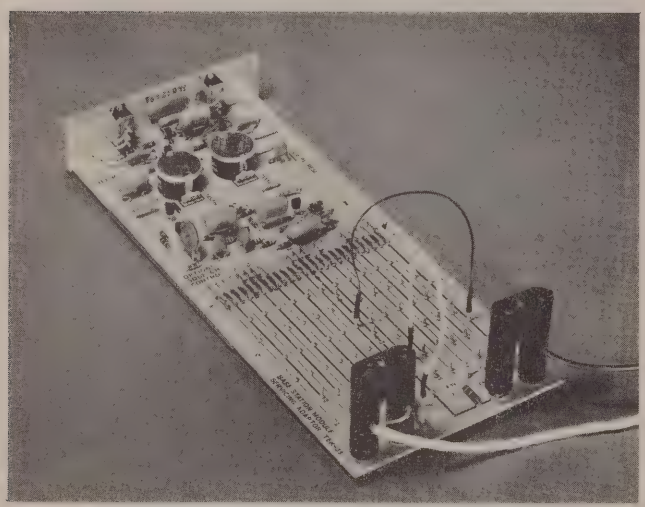


FIGURE 20. THE SQUELCH CONTROL DECODER CONNECTED TO THE TEK-38 SERVICING ADAPTER

Connections are made to the circuit module via the TEK-38 adapter by the use of push-on patch leads and patch pins on the TEK-38. Each module connection has at least three patch pins for multiple connections. A+ and ground connections have six patch pins since they are used frequently.

A+ is supplied to the module via the double banana connector supplied for that purpose. A small bench power supply such as a Motorola TEK-23, Figure 21, is suitable for this purpose.

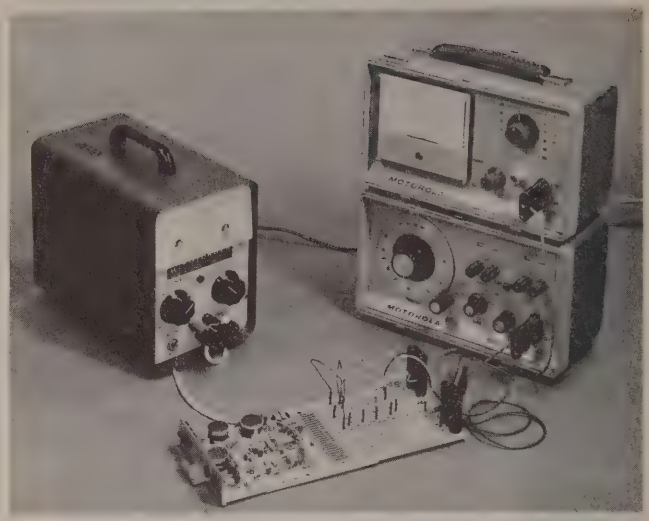


FIGURE 21. SERVICING THE F2-R2 MUTE MODULE USING THE TEK-38 BASE STATION MODULE SERVICING ADAPTER.

An 8.8 V source is provided for those modules using this voltage, such as F1 and F2 Modules in Tone systems, and the D.C. Transfer Modules in D.C. systems. The voltage source should be used in place of the voltage divider indicated on the individual module service instructions.

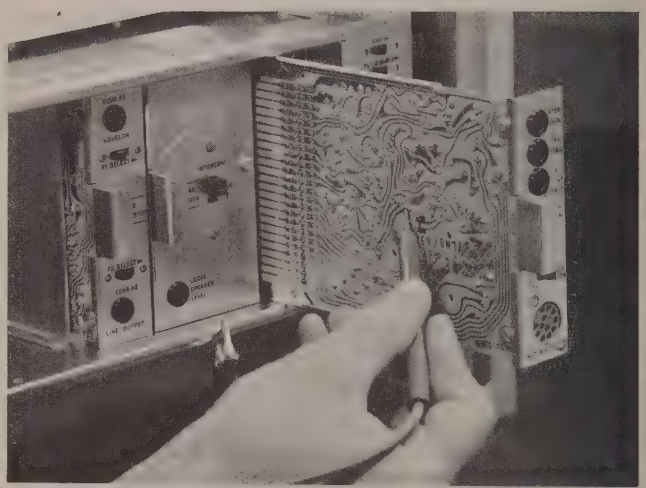


FIGURE 22. SERVICING THE STATION LOGIC MODULE IN THE TLN 6799A EXTENSION BOARD.

For servicing Base Station Modules at the Base Station site a TLN 6799A extension board allows access to all points of the circuit while maintaining the module in an operational state.

The Guardtone Decoder Module is shown installed in the TLN 6799A extension board in Figure 22.

A connector is provided for module audio input. Note that audio may be coupled either directly

or through a capacitor, as required, to any pin by a patch lead. An ideal audio source is the Motorola S1067A Audio Oscillator.

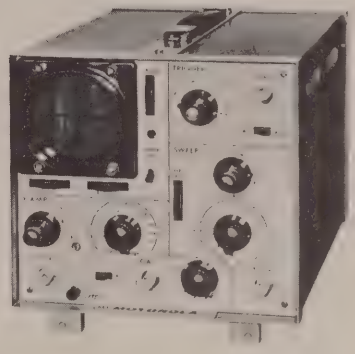
The patch lead kit supplied with the TEK-38 contains six red, six black, and six white leads. Also supplied are six 10 K ohm and two 100 K ohm resistor patch leads. The leads are attached by means of the push-on connector.

Note: It is not necessary to push the connector completely on to the pin. Connector life will be extended and installation simplified if the patch leads are pushed on just until the detent is engaged. Typically, the red leads can be used for A+ connections, black leads for ground connections, and white for "other" purposes (8.8 V, audio, etc.). In a pinch, Minigator clip leads make good substitutes for patch leads.

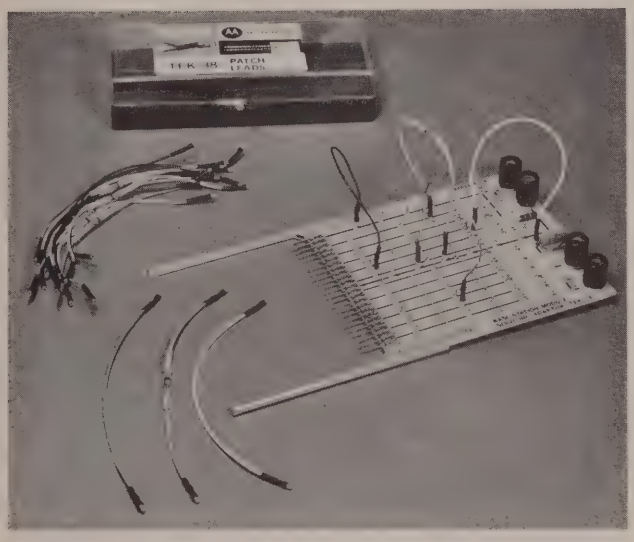
RECOMMENDED TEST EQUIPMENT

S1063A DC Multmeter

TEK-23 Power Supply



S1301A Oscilloscope

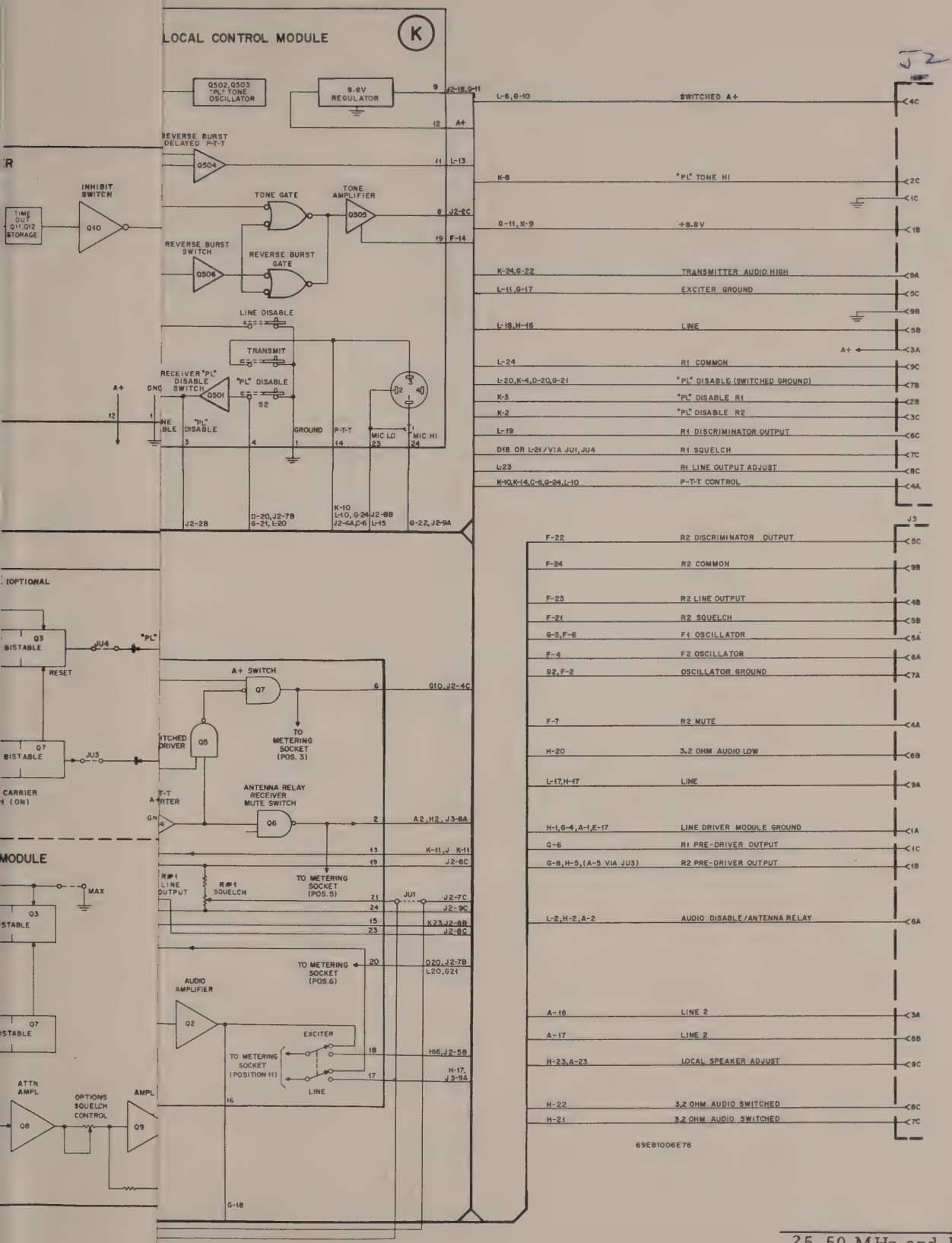


TEK-38 Base Station Module Servicing Adapter

S1078C Digital Frequency Meter With Deviation Monitor

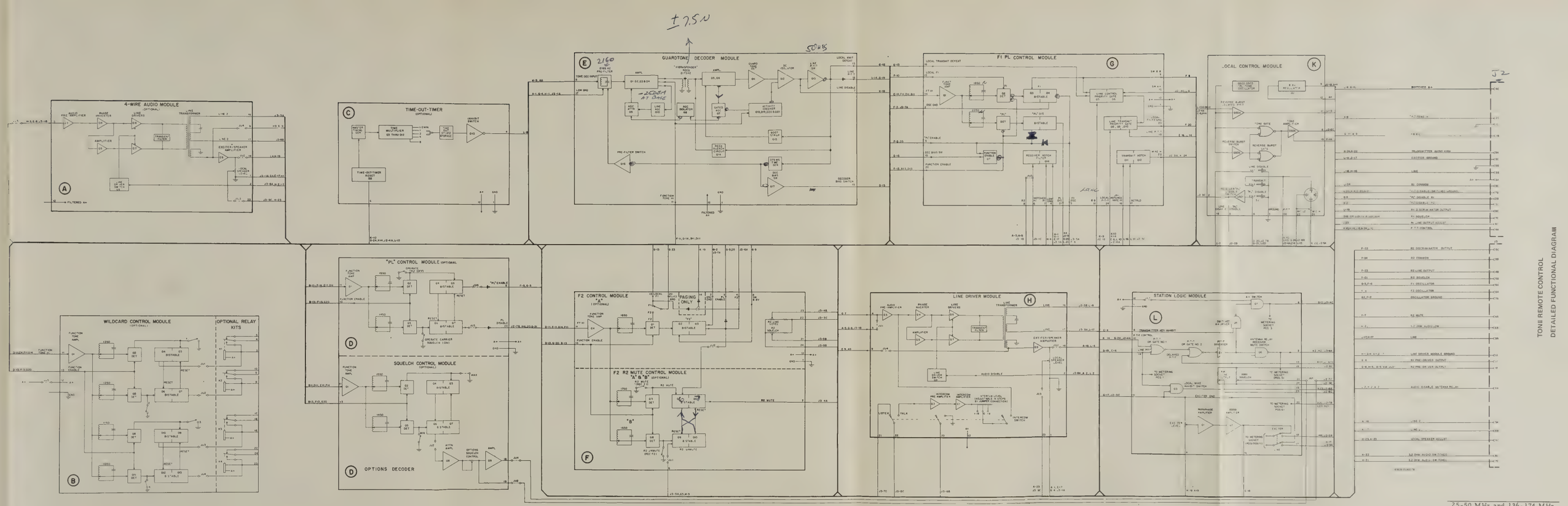
S1067A Audio Oscillator

S1051C AC Voltmeter



TONE REMOTE CONTROL
DETAILED FUNCTIONAL DIAGRAM

25-50 MHz and 136-174 MHz
Base Station FM Radio
Detailed Functional Diagram
Motorola No. PEPS-2368-A
(Sheet 1 of 2)
10/17/69-UP



25-50 MHz and 136-174 MHz
Base Station FM Radio
Detailed Functional Diagram
Motorola No. PEPS-2368-A
(Sheet 1 of 2)
10/17/69-UP

TONE REMOTE CONTROL CHASSIS
MODEL TCN1066A

1. APPLICATION

a. Line Tones

This chassis, together with the associated plug-in modules, permits control of the station from a remote location. Audio-frequency tones generated at the remote control point are carried over wire lines to the station. This chassis and the associated plug-in modules convert the various tones into corresponding switching functions such as transmitter keying, frequency selection, and "Private-Line" disabling.

b. Types of Modules

The basic remote control chassis is used in both repeaters and base station applications. Solid-state plug-in modules are used. All base stations are equipped with the following modules -- Guard Tone Decoder, Station Logic, F1 Decoder, and Line Driver. Repeater stations are also equipped with a Squelch Gate and Time-Out Timer Module. Space is provided for additional optional accessory modules.

(1) Station Logic Module

This module provides sequencing, timing and control functions for remote operation of the station. It also amplifies line audio to the proper level for the exciter. The following switches and controls are found on this module:

- XCTR LEVEL -- sets audio input to exciter.
- R1 LINE OUTPUT -- sets receiver #1 line output level.
- R1 SQU Control -- controls receiver #1 squelch sensitivity setting.
- LINE/XCTR AUDIO Switch -- selects exciter or line audio level measurement at the metering socket.
- METER SCKT -- permits the serviceman to connect a Motorola Portable Test Set for servicing remote control unit logic malfunctions.

LOGIC CIRCUITS METERING TABLE

SET-UP PROCEDURE
1. Function switch to XMTR position on Portable Test Set.
2. Oscillator switch to METER REV position on Portable Test Set.
3. Audio switch to XCTR position on Station Logic Module.

PORTABLE TEST SET SWITCH POSITION	CIRCUIT METERED	TYPICAL READING	
		STANDBY	TRANSMIT
1	Line P-T-T	25 uA (min)	0
2	Redundancy	25 uA (min)	25 uA (min)
3	Switched A+	0	25 uA (min)
5	Antenna Relay Switch, Receiver Mute, Line Driver Disable	25 uA (min)	0
6	"PL" Disable	20 uA (min)	0*
11	Line Audio	**0.34 v ac	N/A
	Exciter Audio	**N/A	Per Exciter Sensitivity Label

*Meter reading is for "PL" disable condition rather than transmit condition.

**Dependent upon audio levels used at the individual station. Refer to the INSTALLATION AND INITIAL ADJUSTMENT section of the manual for set-up instructions and typical readings.

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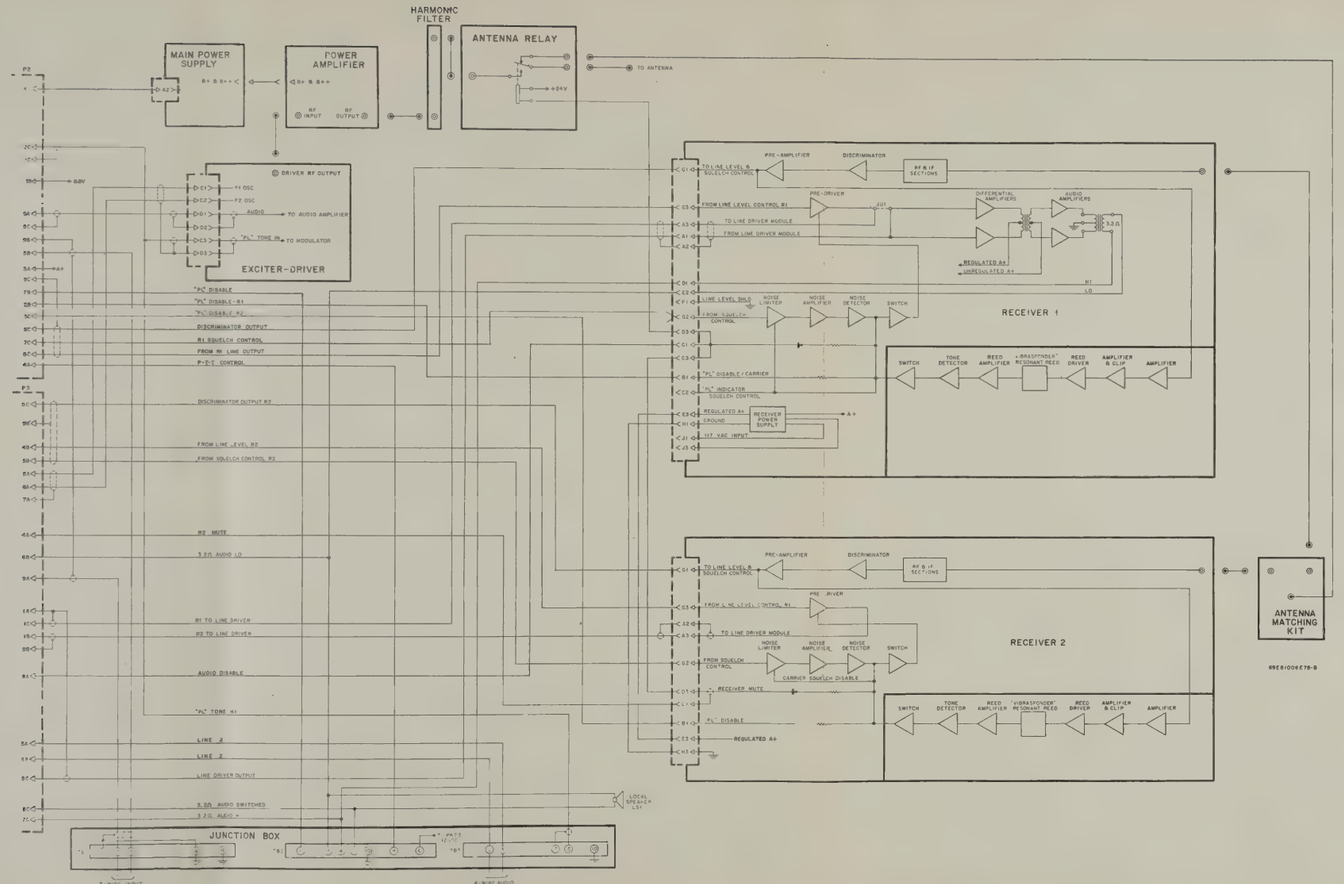
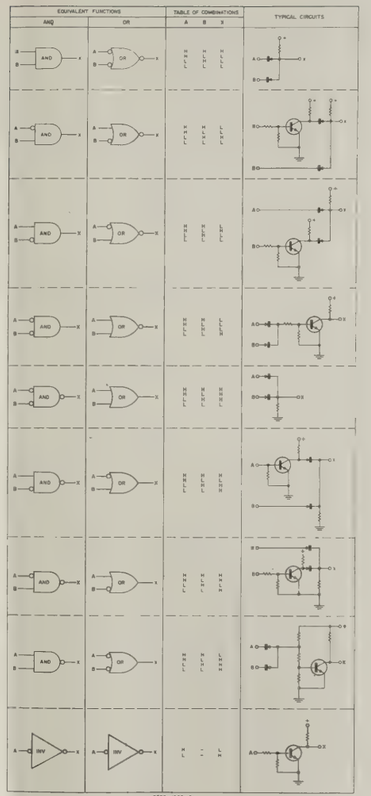
TONE REMOTE CONTROL
DETAILED FUNCTIONAL DIAGRAM





25-50 MHz and 136-174 MHz
Base Station FM Radio
Detailed Functional Diagram
Motorola No. PEPS-2368-A
(Sheet 2 of 2)
10/17/69-UP

TONE REMOTE CONTROL CHASSIS
MODEL TCN1066A

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a. Line Tones

This chassis, together with the associated plug-in modules, permits control of the station from a remote location. Audio-frequency tones generated at the remote control point are carried over wire lines to the station. This chassis and the associated plug-in modules convert the various tones into corresponding switching functions such as transmitter keying, frequency selection, and "Private-Line" disabling.

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5	Antenna Relay Switch, Receiver Mute, Line Driver Disable	25 uA (min)	0
6	"PL" Disable	20 uA (min)	0*
11	Line Audio	**0.34 v ac	N/A
	Exciter Audio	**N/A	Per Exciter Sensitivity Label

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**Dependent upon audio levels used at the individual station. Refer to the INSTALLATION AND INITIAL ADJUSTMENT section of the manual for set-up instructions and typical readings.

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(2) Guard Tone Decoder Module

This decoder supplies a push-to-talk voltage when a 2175 Hz guard tone is received over the control line from the associated remote control point. In addition, the decoder amplifies received control tones and distributes them to other decoders through the remote control chassis circuit board.

(3) Squelch Gate Module

The squelch gate is used for keying the transmitter in repeater applications. It accomplishes this by monitoring the receiver quieting level, and when the noise drops below the threshold value, it provides an output for keying the transmitter. (In "Private-Line" tone-coded squelch stations, it also requires a PL tone.) The threshold level is adjustable to permit transmitter keying at approximately 10 to 25 dB receiver quieting. The following controls are found on this module:

● REPEATER SQUELCH KEY -- used to adjust the noise input from the receiver discriminator to the desired threshold level.

● REPEATER LEVEL -- used to adjust the receiver audio level to match the line audio level, and is in the circuit only during repeater operation.

(4) Time-Out Timer Module

The Time-Out Timer Module is used to limit transmission time. In base station applications, it limits the continuous transmission time, while in repeater applications, it limits the transmission times of individual users but not the period of continuous transmission that would occur if it was keyed during the turn-off delay. The unit can be preset for 1/2, 1, 2, 4, or 8 minutes operation.

(5) F1 Decoder Module

This module provides a switched ground to the transmitter channel element when it detects a 1950 Hz tone, and provides PL disabling of the receiver when it detects a 2050 Hz tone (in PL stations only).

(6) Line Driver Module

This module amplifies and routes the received audio to the remote control point and couples the audio from the remote control point to the transmitter. The following controls are found on this module.

● INTERCOM Switch -- permits intercom operation between the station site and remote control point(s).

● LOCAL SPKR LEVEL control -- permits adjustment of audio level for local speaker monitoring.

(7) F2 Control Module

This module provides a switched ground to the transmitter F2 channel element when it detects an 1850 Hz tone.

(8) C2-R2 Control Module

On stations with two-frequency transmitters and receivers, this module provides switched ground to the transmitter F2 channel element when it detects an 1850 Hz tone, receiver F1 channel element when it detects a 1750 Hz tone, and receiver F2 channel element when it detects a 1650 Hz tone.

c. Optional Modules

The options decoder slot in the remote control chassis will accept one of the following modules -- Repeater Control, PL Control or Squelch Control. Additional modules that may be added are Time-Out Timer, 4-Wire Audio, Single-Tone Decoder, and "Wild Card" Control. The F2-R2 Mute Module can be used instead of an F2 Control Module.

(1) Time-Out Timer

The Time-Out Timer is standard in the repeater models, and may be added to the base stations as an option. As in the repeater, it is used to limit the length of any single transmission to a preset period of 1/2, 1, 2, 4, or 8 minutes.

(2) Four-Wire Audio Option

When the station is equipped for 4-wire audio operation (i.e., two line driver modules), two separate audio pairs can be used. A variety of operational options are available, depending upon the jumpers used and the connection of the lines to the station. Refer to the line driver module section in this manual for jumpering information.

(3) Single-Tone Decoder

The single-tone decoder module requires that the incoming rf signal be initially modulated with a tone burst of a specific frequency for selective signalling.

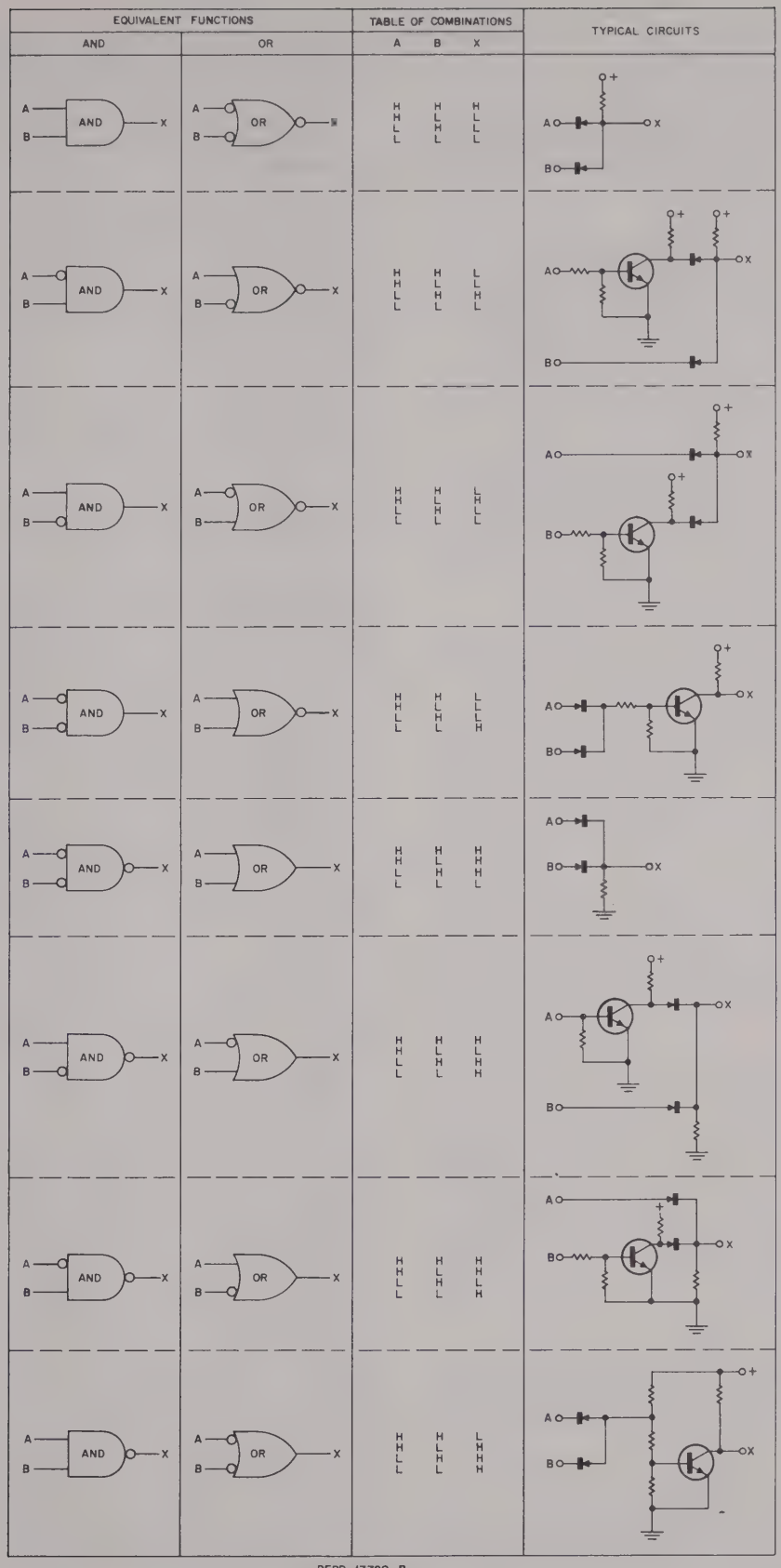


Figure 1.
Chart of Typical AND and OR Logic Presentations and Typical Equivalent Circuit Diagrams

(4) Repeater Control Module

This module provides tone control for repeater (RT) turn-on and turn-off, thereby offering operation as a base station or repeater.

(5) "PL" Control Module

This module provides tone selection of "Private-Line" tone-coded squelch or carrier squelch operation, and does not reset when the transmitter is keyed.

(6) "Wild Card" Control Module

This module contains four tone sensitive circuits for operating distant functions through switched transistor outputs or in conjunction with optional relay kits for heavier current switching requirements. Refer to the "Wild Card" Control Module section for additional information.

(7) Paging Decoder Module (Single-Frequency Stations Only)

This module provides transmitter "Private-Line" tone-coded squelch inhibiting when carrier squelch receiver paging is desired. Refer to the Paging Decoder Module section for additional information.

(8) Squelch Control Module

This module selects threshold or maximum squelch level as desired. Refer to the Squelch Control Module section for additional information.

(9) F2-R2 Mute Module

This module controls the line level and squelch for a second receiver. It also controls frequency selection and receiver unmuting functions. Refer to the F2-R2 Mute Module section for additional information.

2. DESCRIPTION

The remote control chassis mounts plug-in modules that perform switching functions for station operation. It also includes a local control panel.

Nylon guide rails snapped into place in this chassis align the modules to mate with connecting pins on the interconnect circuit board at the rear of the chassis.

The local control panel provides the following local control facilities for service and maintenance.

- XMIT Switch -- for local keying of the transmitter.
- "PL" DISABLE Switch -- disables receiver "Private-Line" tone-coded squelch operation.
- LINE DISABLE Switch -- disables the tone control input circuits to prevent remote operation of the transmitter.
- LOCAL MIKE -- allows the use of a local microphone for transmitter service and maintenance.

3. BASIC CIRCUITS

Several basic circuits are used extensively in the logic circuitry of the Remote Control Unit. The AND gate, the OR gate, the transistor switch, the Schmitt trigger and the bistable multivibrator are the most common. These circuits are described in the following paragraphs.

a. AND and OR Logic

An AND gate has two or more inputs and a single output. All inputs (A and B and C and etc.) must be in the "active" state before the output will be switched from the "inactive" to the "active" state.

An OR gate also has two or more inputs and a single output. Any input (A or B or C or etc.) which is in the "active" state will switch the output from the "inactive" to the "active" state.

Binary logic circuits have two states which are designated "active" and "inactive". Each of these states may be either of two distinct voltage levels. These voltage levels are designated "high" and "low". The more positive voltage source is considered to be the "high" level and the less positive voltage source is considered to be the "low" level. The "high" and "low" levels are represented by the letters "H" and "L" in the logic truth table. Logic symbols for AND and OR gates show the "high" and "low" voltage levels as follows: A small circle at the input to a gate indicates that the "low" level activates the function. Conversely, the absence of a small circle indicates that the "high" level activates the function. The same is true of the output. A small circle at the output indicates that the "low" level is present when the function is activated and absence of the circle

indicates that the "high" level is present when the function is activated.

For example, the first AND gate shown in Figure 1 requires two "high" inputs before the output will be a "high". In all other input conditions, the AND gate will be "inactive" and the output will be "low". In the first OR gate, input A or input B is in the "active" condition when the voltage level is "low". When either of the inputs is "low", the output will also be "low" (active state).

b. Transistor Switches

A switch is characterized by a high resistance in one state and a low resistance in another. Transistors operate as switches if they are operated under nonconducting (cut off) conditions where the resistance of the emitter to collector junction is very high or full saturation conditions where the resistance of the emitter to collector junction is very low. Figure 2. shows the configuration of typical transistor switches.

The transistor switches used in the Remote Control Unit are connected in either the common emitter or common collector configuration. In the common emitter configuration, an inverted output is obtained. With no input signal, there is no forward bias on the transistor, the transistor is cut off and the collector voltage approaches the supply voltage. When an input signal drives the base positive, the transistor is forward biased and starts to conduct. In full saturation, the collector voltage approaches the emitter voltage which is at ground potential.

A non-inverted output is obtained when the transistor is connected in the common collector configuration. With no input signal, the transistor is cut off and the emitter is at ground potential. When a positive input voltage is applied, the transistor is forward biased and the emitter voltage follows the base voltage until the collector voltage (supply voltage) is approached. A large power gain can be obtained from the common collector circuit, however, the voltage gain is always less than one.

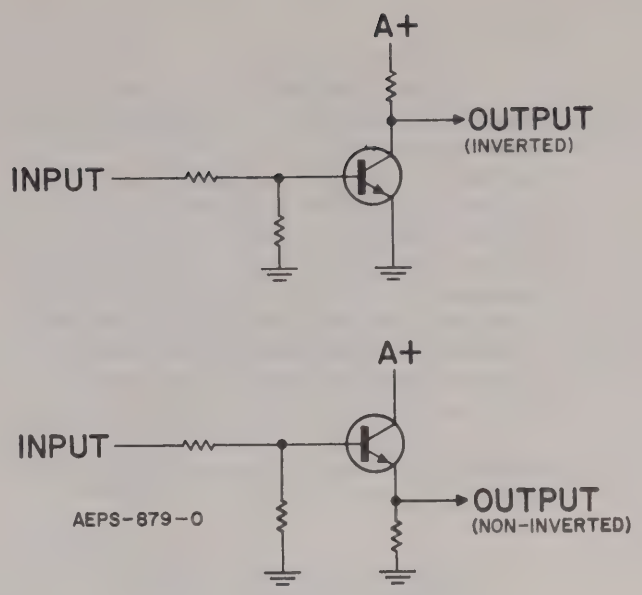


Figure 2.
Typical Transistor Switches

c. Schmitt Trigger

A Schmitt trigger is a regenerative bistable circuit whose state depends on the amplitude of the input voltage and where feedback is provided by the use of a common emitter resistor. Figure 3 shows the configuration of a typical Schmitt trigger circuit. The output of the Schmitt trigger will be one value if the input exceeds a given level and the output will return to its initial value if the input goes below another level. The circuit is used for detecting a dc level and providing a fast rise square wave output.

In the initial state, Q1 is biased at cutoff and Q2 is biased into conduction. The common emitter voltage is a function of the voltage divider formed by R5 and R7.

When the input drives the base of Q1 positive, Q1 starts to conduct. Its collector voltage drops and this voltage is coupled through R4 to the base of Q2, turning it off. With Q2 in the off state, its collector voltage rises abruptly from its original

low level. The common emitter voltage is now a function of the voltage divider formed by R5 and R3.

To return the Schmitt trigger circuit to its original state, the input voltage must drop to a level which no longer forward biases the base of Q1. The output of a Schmitt trigger may be taken at the collector of either Q1 or Q2. The output at the collector of Q1 will be inverted while the output at the collector of Q2 will be non-inverted.

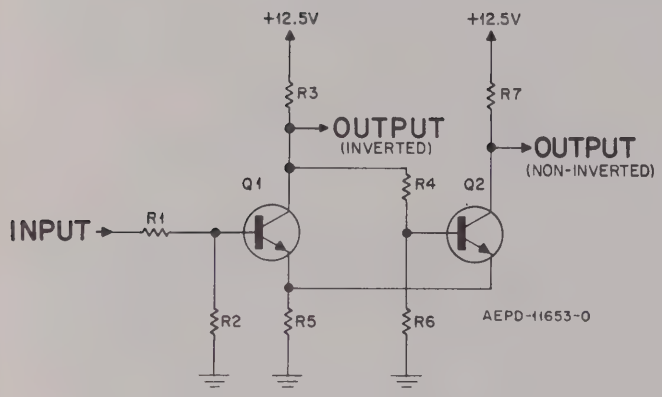


Figure 3.
Typical Schmitt Trigger

d. Bistable Multivibrator

The bistable multivibrator is a double input switching circuit whose state is determined by the input applied and where feedback is used to maintain a given state. Figure 4. shows the configuration of a typical bistable multivibrator circuit.

Due to normal variations in the multivibrator circuit, one transistor will saturate and the other will be cut off upon initial application of dc power. Each transistor is held in its particular state by the condition of the other.

Assume that Q1 begins conducting first when power is applied. The collector voltage of Q1 will attempt to approach the emitter voltage (ground). This voltage is coupled to the base of Q2 through R3, preventing Q2 from conducting. When Q2 is cut off, the collector voltage attempts to rise to the supply voltage. This voltage is coupled through R4 to the base of Q1, driving it further into conduction which, in turn, lowers the voltage being coupled to the base of Q2 even more. This sequence continues until one transistor is saturated and the other is cut off.

The inputs are positive voltage signals applied to the bases of the bistable circuit. A positive voltage applied to input #2 forces transistor Q2 to conduct. As Q2 conducts, the collector voltage begins to decrease. This decrease in voltage appears at the base of Q1, cutting it off. When Q1 stops conducting, the collector voltage attempts to rise to the supply voltage. This voltage is then coupled through R3 to the base of Q2, driving it further into conduction.

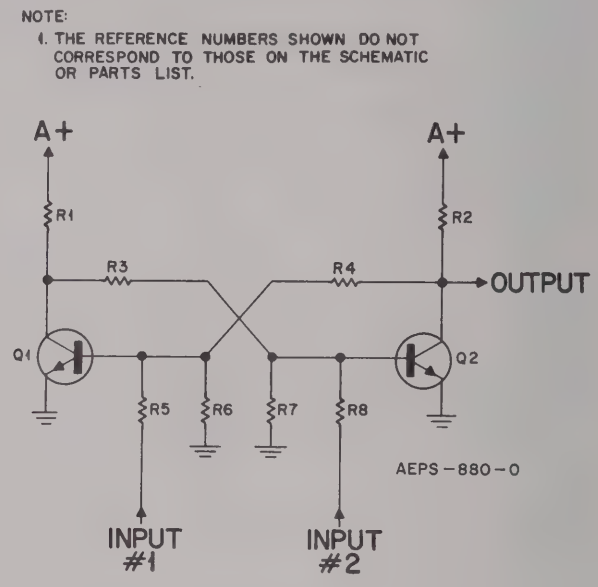


Figure 4.
Typical Bistable Multivibrator

The desired output of the bistable multivibrator circuit may be selected by applying a positive voltage to the appropriate input. If a positive voltage is applied to input #1, the output will approach the level of the collector supply voltage of Q2. If a positive voltage is applied to input #2, the output will approach zero volts. An output may also be taken from the collector of Q1. This will be inverted from the Q2 collector output.

4. SERVICE AND MAINTENANCE

NOTE

Specialized maintenance procedures for individual modules are described in the respective module sections in this manual.

a. Removal and Replacement of Modules

Modules may be removed by simply pulling outward on the module, and may be replaced by pushing the module into its position in the panel. The modules are labelled and the mounting positions are marked on the Interconnect Board at the inside rear of the module housing.

CAUTION

1. Never attempt to plug a module into the pins on the back of the Remote Control Unit.
2. Always be sure of the correct module position before plugging in a module.
3. There are keying plugs in some modules to prevent insertion in the wrong position. Do not remove these plugs from the modules except when using the servicing kit.
4. Remove power to the station before inserting or removing modules to prevent damage to transistors by transients.

Technicians who service many of these stations may wish to carry spares and replace malfunctioning modules for immediate restoration of operation. The module may then be repaired at the shop and used as the next replacement spare.

NOTE

All jumper connections must be identical on modules that are removed and modules that are inserted before swapping can be successfully used as a troubleshooting technique.

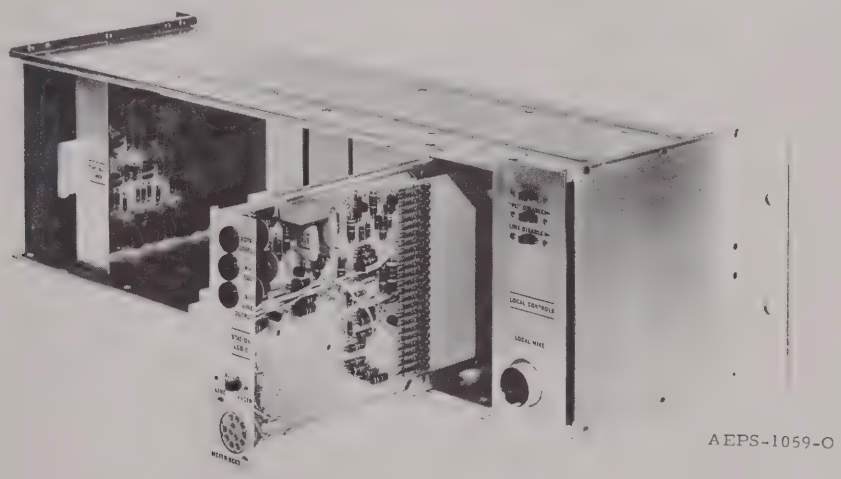
To remove the station local control panel, the station logic module and two mounting screws on the front panel of the local control panel must be removed. Sufficient service loop is provided in the panel intercabling to allow free movement of the panel to pull it out for service. Individual plug-in pins mate with the interconnect board and are identified with a numbered sleeve on the female pin.

b. Installation of Additional Modules

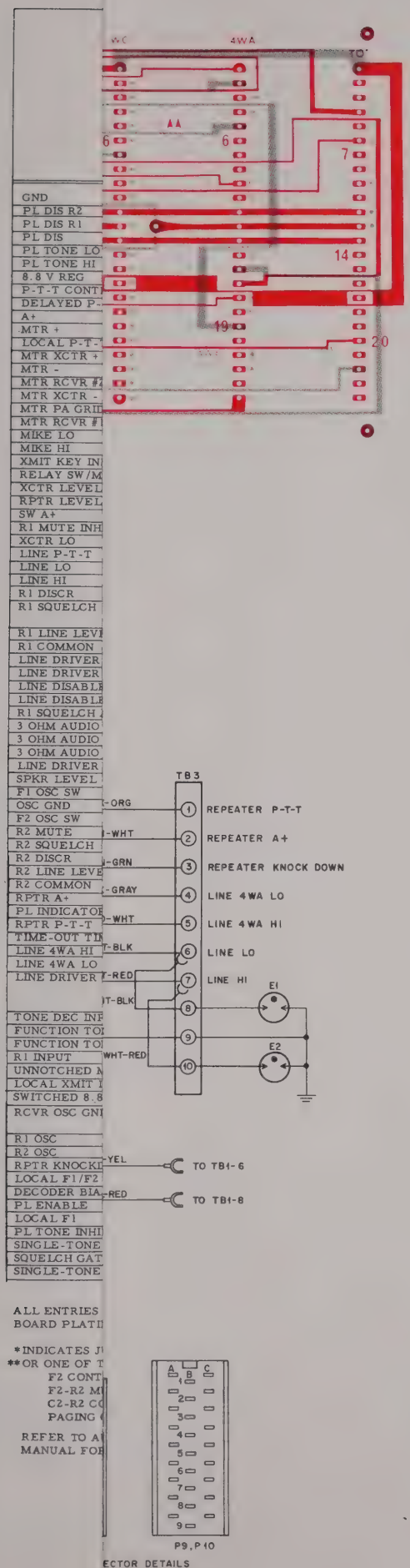
When new functions (optional modules) are added, refer to the pertinent module section in this manual for proper jumpering information.

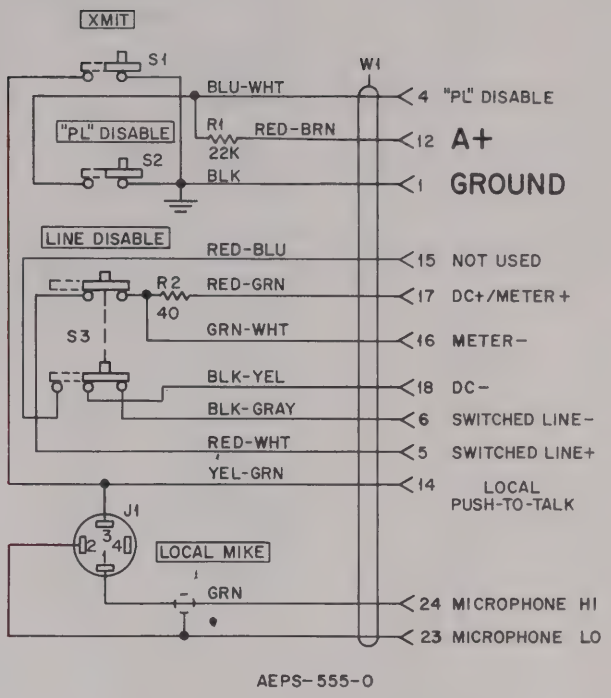
c. In-Circuit Module Servicing

The Motorola Model TLN8799A Service Board Kit is available for extending the module to provide access for service and maintenance without interrupting the power and signal connections when taking readings.



Module Extended for Service and Maintenance





AEPS-555-O

TONE REMOTE CONTROL CHASSIS

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TCN1066A Tone Remote Control Chassis
Wiring Diagram
Motorola No. 63P81006E87-A
1/2/70-UP

MODULE INTERCONNECTION CHART

	LOCAL CONTROL	STATION LOGIC	LINE DRIVER	#1 P.L. CONTROL MODULE	GUARD TONE DECODER MODULE	SQUELCH GATE	SINGLE-TONE DECODER**	OPTIONS DECODER	"WILD CARD" CONTROL MODULE	4-WIRE AUDIO	TIME-OUT TIMER	P9	P10	JUMPER
GND	1	1		1	1	1	1	1	1		1	9B		
P.L. DIS R2												3C		
P.L. DIS R1												2B		
P.L. DIS	4	20		21				20			20	7B		
P.L. TONE LO												1C		
P.L. TONE HI												2C		
8.8 V REG				11								1B		
P-T-T CONTROL		10										1A		
DELAYED P-T-T		13										2A		
A-	12	12	12	12	12	12	12	*12	*12	12	12	3A		5
MTR +												3B		
LOCAL P-T-T	14			24		18					6	4A		
MTR XCTR +												4B		
MTR -	16											5A		
MTR RCVR #2												6A		
MTR XCTR -							14					6B		
MTR PA GRID												7A		
MTR RCVR #1												8A		
MIKE LO	23	15										8B		
MIKE HI	24			22								9A		
XMIT KEY INHIBIT		8									4			
RELAY SW/MUTE		2	2							2			8A	
XCTR LEVEL		4	19							19				6
RPTR LEVEL		5				13								
SW A+		6		10	6	6						4C		
R1 MUTE INHIBIT		7				17								
XCTR LO		11		17		24				15		5C		
LINE P-T-T		14		19	16	16								
LINE LO		17	17										9A	
LINE HI		18	16									5B		
R1 DISCR		19				10	3					6C		
R1 SQUELCH		*21						*19				*7C		1, 2, 4
R1 LINE LEVEL		23										8C		
R1 COMMON		24										9C		
LINE DRIVER R1 INPUT			4	7										
LINE DRIVER R2 INPUT			5	*8						*5			13	3
LINE DISABLE	18				7									
LINE DISABLE GND	6, 1													4
R1 SQUELCH ATTN								18						
3 OHM AUDIO LO			20										6B	
3 OHM AUDIO HI			21										7C	
3 OHM AUDIO SW			22										8C	
LINE DRIVER OUTPUT			23										9C	
SPKR LEVEL			24							24				
#1 OSC SW				3	3	3	6						5A	
OSC GND				2	2	2	2						7A	
#2 OSC SW							4						6A	
R2 MUTE							7						4A	
R2 SQUELCH							21						5B	
R2 DISCR							22						5C	
R2 LINE LEVEL							23						4B	
R2 COMMON							24						9B	
RPTR A+						20							6C	
P.L. INDICATOR						14							3C	
RPTR P-T-T						15							3B	
TIME-OUT TIMER RESET						22					22			
LINE 4WA HI										16			3A	
LINE 4WA LO										17			8B	
LINE DRIVER GND			1	4	17					1			1A, 2A, 2B	
TONE DEC INPUT			9		9					9				
FUNCTION TONE HI				14	11		11	11	11	11	11			
FUNCTION TONE LO				20			13	13	13	13	13			
R1 INPUT			3	6									1C	6
UNNOTCHED MIKE HI		16		18										
LOCAL XMIT DEFEAT				16	15									
SWITCHED 8.8 V				9			8							
RCVR OSC GND							16, 1						2B	
R1 OSC							15						2C	
R2 OSC							17						4C	
RPTR KNOCKDOWN						21		9					7B	
LOCAL F1 F2 GND				23			20		7					
DECODER BIAS SW				15	15									
P.L. ENABLE				5			5	5						
LOCAL F1				13			10							
P.L. TONE INHIBIT							14						2A	
SINGLE-TONE RESET						8	9							
SQUELCH GATE INHIBIT						19	18							
SINGLE-TONE SW GND							19							

ALL ENTRIES ON A HORIZONTAL LINE ARE COMMON POINTS WHICH ARE INTERCONNECTED BY THE BOARD PLATING.

*INDICATES JUMPER CONNECTIONS TO OTHER POINTS IN SAME COLUMN OR ROW.

**OR ONE OF THE FOLLOWING MODULES:
- F2 CONTROL
- F2-R2 MUTE CONTROL
- C2-R2 CONTROL
- PAGING CONTROL

REFER TO AUDIO AND CONTROL LINE CONNECTION CHART IN INSTALLATION SECTION OF THIS MANUAL FOR JUMPER CONNECTION INFORMATION.

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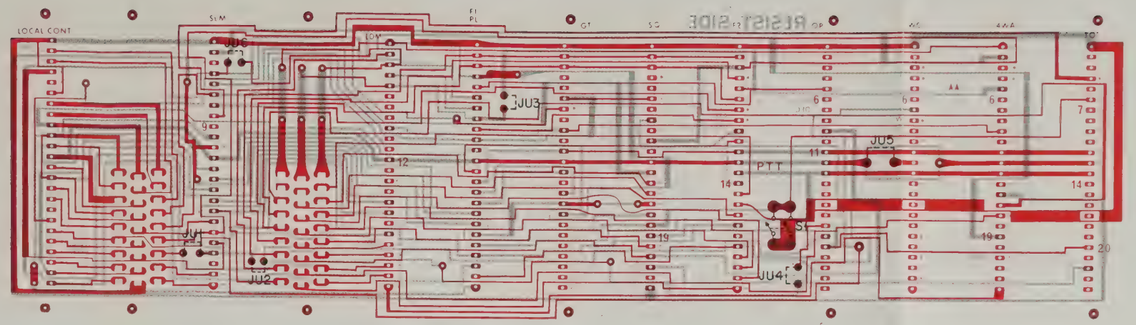
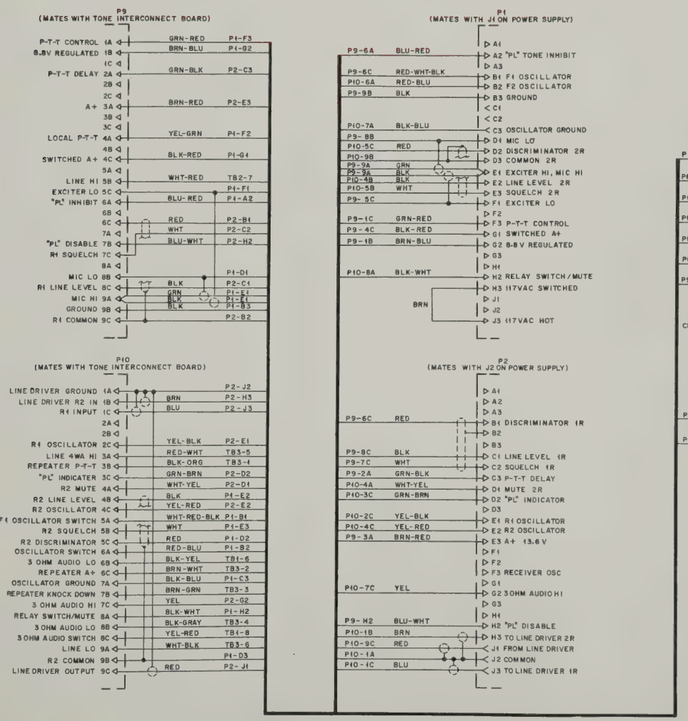
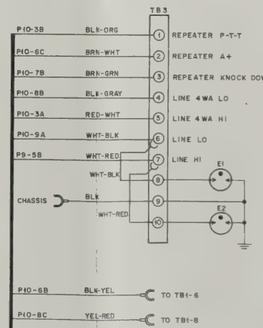
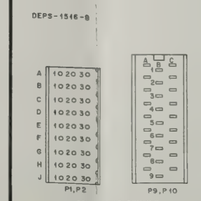
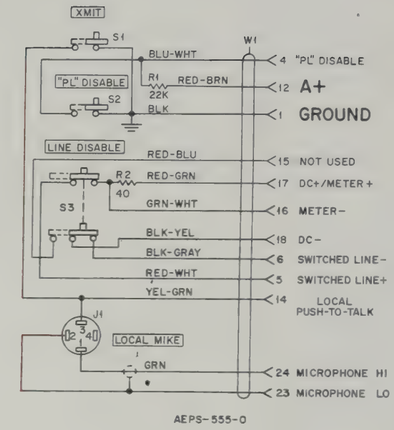










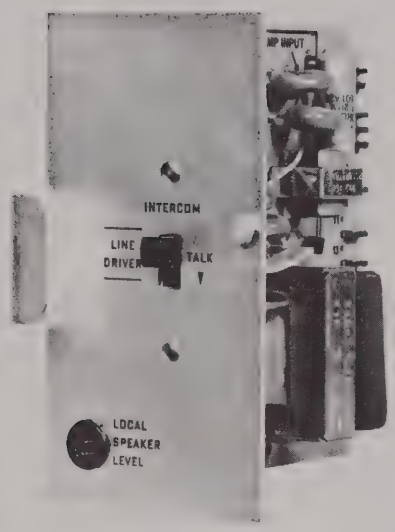
AEPS-555-0

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TCN1066A Tone Remote Control Chassis
Wiring Diagram
Motorola No. 63P81006E87-A
1/2/70-UP

LINE DRIVER MODULE

MODEL TLN1172A



1. DESCRIPTION

The TLN1172A Line Driver Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed. This module is also used as the 4-Wire Audio Module in stations so equipped.

2. FUNCTIONS

The line driver module amplifies the output from the station receiver to a level suitable for application to the wire line between the station and the remote control point. It also contains the amplifier and switching facilities for intercommunication between a local speaker at the base station and the remote control console or desk set at the opposite end of the wire line.

Audio from the wire line is amplified before being applied to the transmitter exciter stages.

3. CIRCUIT DESCRIPTION

a. Receiver Audio To Line

When an audio output from the receiver enters the module on pin 4 or 5, it is amplified in preamplifier stage Q3. The signal then passes through phase inverter Q4. From the phase inverter, the signal goes to line driver Q6, and amplifier Q5 through blocking capacitor C10 and attenuating resistor R17, where it is 180 degrees out-of-phase with the signal at the base of Q6. The out-of-phase signals are fed to line driver transistors Q6 and Q7, which then apply the amplified audio signal to the line transformer and the line.

b. Line To Transmitter Exciter

The audio signal entering the transformer on the line windings is coupled out through the tertiary winding, terminals 7 and 9, into Exciter/Speaker Amplifier stage Q9. After amplification in this stage, which is operated as an

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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8760A Local Station Control Panel — PL-268-O

J1	9K830418	CONNECTOR, receptacle: female; 4 contact; does not include; 4S7699 LOCKWASHER 13/16"; 2A482070 NUT, ring
R1	6S128685	RESISTOR, fixed: 22K ±10%; 1/4 w
R2	17C82036G31	40 ±2%; 2 w
S1, 2	40B83468E01	SWITCH, slide: spst
S3	40B83204B01	dpst
W1	1V80700B34	CABLE ASSEMBLY: includes ref. parts R1, R2, misc. leads and the following: 9B83012H01 RECEPTACLE, wire crimp; 11 req'd.
		SLEEVING, coded
	37C82603D01	No. 1
	37C82603D04	No. 4
	37C82603D05	No. 5
	37C82603D06	No. 6
	37C82603D12	No. 12
	37C82603D14	No. 14
	37C82603D16	No. 16
	37C82603D17	No. 17
	37C82603D18	No. 18
	37C82603D23	No. 23
	37C82603D24	No. 24
NON-REFERENCED ITEM		
	64B83916G01	BRACKET, panel

TLN4058A Interconnect Board — PL-553-O

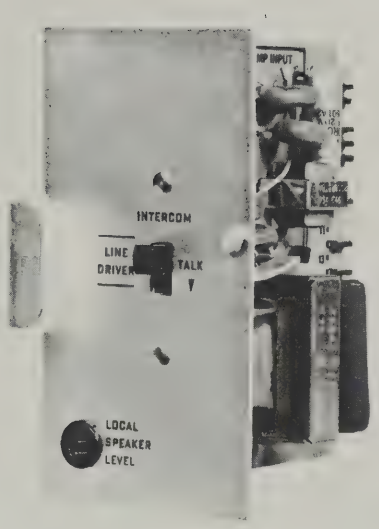
	40B82786A02	SWITCH, push: dpst; momentary
	29C84028H09	TERMINAL, contact: male
	9B83965G01	TERMINAL, contact: female

TKN6410A Cable Kit — PL-575-O

E1, 2	80B83029H01	SPARK-GAP: 230 V dc; shunt capacity 2 pF
P1, 2		CONNECTOR, plug: includes: 14C82337A11 INSULATOR, 27 circuit; 29C82336A01 TERMINAL, pin: female; 29C82335A01 TERMINAL, pin; male and 15C83934A11 COVER, connector
P9, 10		includes; 14B83033H01 INSULATOR, 27 circuit; 29C83013H02 TERMINAL, pin; 5A483208 GROMMET and 15B83096H01 COVER, connector
TB3	31B848187	BOARD, terminal: 10 terminals
NON-REFERENCED ITEMS		
	29K847854	LUG, slotted tongue
	30C83236B01	CABLE, shielded: 3-conductor
	30C83348B03	WIRE, shielded: BLK
	30C83348B01	WIRE, shielded: BROWN
	30K865737	WIRE, shielded: RED
	30K863486	WIRE, shielded: GREEN
	30K865593	WIRE, shielded: BLUE

LINE DRIVER MODULE

MODEL TLN1172A



1. DESCRIPTION

The TLN1172A Line Driver Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed. This module is also used as the 4-Wire Audio Module in stations so equipped.

2. FUNCTIONS

The line driver module amplifies the output from the station receiver to a level suitable for application to the wire line between the station and the remote control point. It also contains the amplifier and switching facilities for intercommunication between a local speaker at the base station and the remote control console or desk set at the opposite end of the wire line.

Audio from the wire line is amplified before being applied to the transmitter exciter stages.

3. CIRCUIT DESCRIPTION

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When an audio output from the receiver enters the module on pin 4 or 5, it is amplified in preamplifier stage Q3. The signal then passes through phase inverter Q4. From the phase inverter, the signal goes to line driver Q6, and amplifier Q5 through blocking capacitor C10 and attenuating resistor R17, where it is 180 degrees out-of-phase with the signal at the base of Q6. The out-of-phase signals are fed to line driver transistors Q6 and Q7, which then apply the amplified audio signal to the line transformer and the line.

b. Line To Transmitter Exciter

The audio signal entering the transformer on the line windings is coupled out through the tertiary winding, terminals 7 and 9, into Exciter/Speaker Amplifier stage Q9. After amplification in this stage, which is operated as an

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emitter-follower, the signal is taken from the emitter and passed through jumper JU2 and pin 19 to the Station Logic Module and the transmitter exciter.

c. Intercommunication With The Remote Control Point

With the INTERCOM-TALK switch held in the TALK position, speaking into the local speaker on the base station routes the signal to intercom preamplifier stage Q2, intercom amplifier stage Q1, and through level adjustment network R1, R2, and R3. The output is adjustable by placement of a jumper for approximately +18 dbm, 0 dbm, or -8 dbm on the line. It is then applied to a phase inverter and amplifier pair which drive the line drivers. The line drivers are coupled to the line by transformer T1 and the voice message is sent over the wire line to the remote point.

The return signal on the wire line is coupled from the line side of transformer T1 through the tertiary winding to the Exciter/Speaker Amplifier and on to the SPEAKER LEVEL control. From the control, the signal passes through pin 23 to the receiver audio amplifier stages and back to the local speaker.

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the circuitry, remove the module, insert a Model TLN8799A Servicing Board Kit, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 20	Ground
4	Audio oscillator through .1 uF
12	+12 volts dc
16	600 ohms to pin 17
17	AC voltmeter to pin 16
22	3.2-ohm speaker to ground

b. Module Malfunction Location Techniques

(1) Make the connections to the modules as indicated in the preceding table.

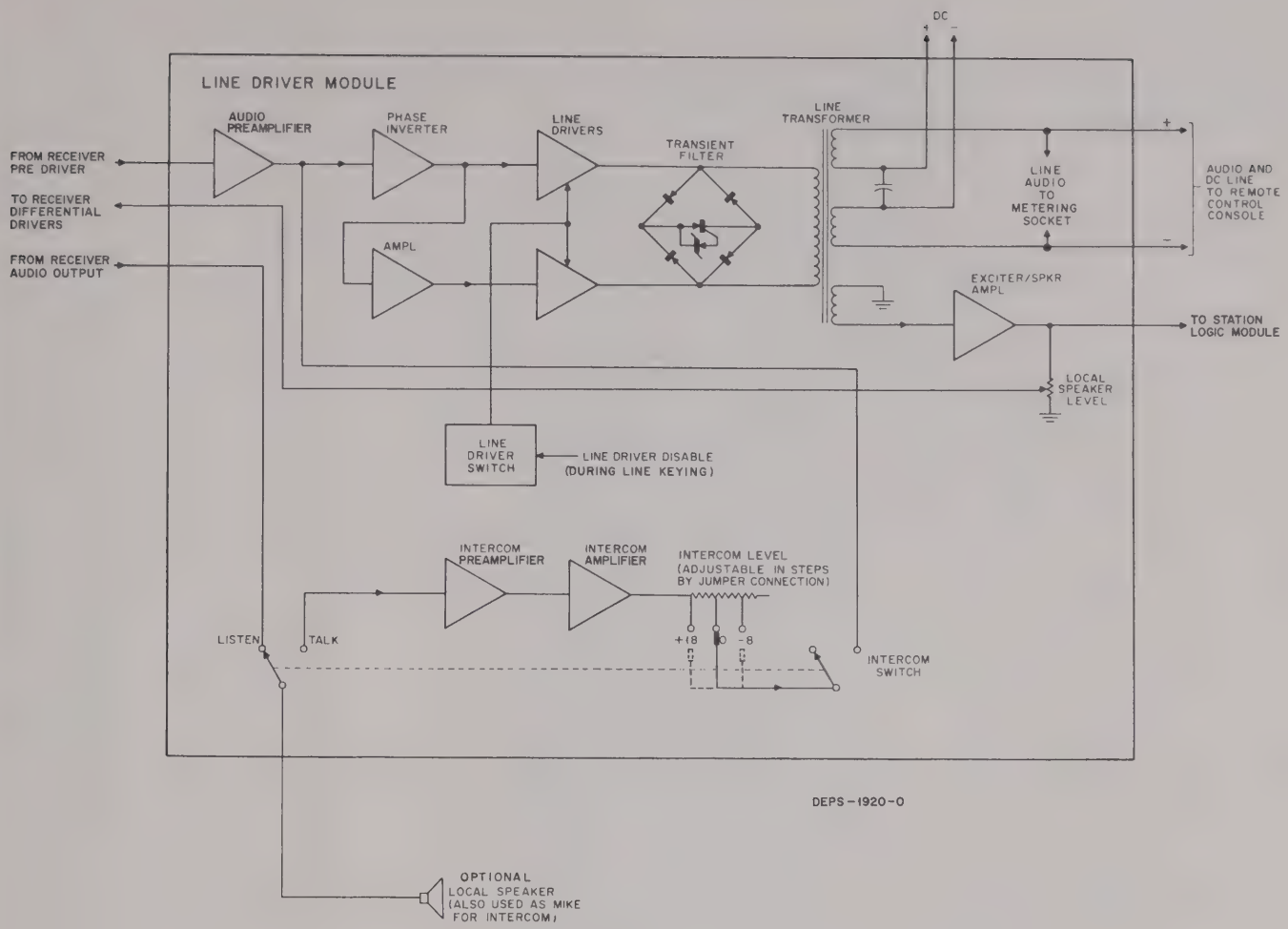
(2) Inject a 1000 Hz tone through the .1 uF capacitor into pin 4. With the tone level at -20 dbm, the voltage measured across the 600-ohm load (pins 16 and 17) should be approximately +14 dbm. If the level is much below this figure, check preamplifier stage Q3, then Phase Inverter Q4, Amplifier Q5, Line Drivers Q6 and Q7, and Line Driver Disable Switch Q8.

(3) Apply a ground to pin 2. The output measured at the 600-ohm load should drop to zero. If this does not occur, investigate diode CR7 and components of the Line Driver Disable Switch stage.

(4) With the same audio input as before, the output measured at pin 19 should be +8 dbm, or 6 db below the previously measured line output. If the appropriate level cannot be obtained, check Exciter/Speaker Amplifier stage Q9.

(5) Move the INTERCOM-TALK switch to the TALK position. Note the position of the AMP LEVEL jumper on the circuit board. Whistle loudly into the speaker connected to the module. The voltmeter connected to the load on pins 16 and 17 should peak at the level selected by the AMP LEVEL jumper (-8, 0, +18 dbm). If difficulty is experienced, check Intercom Amplifier stage Q1 or Intercom Preamplifier stage Q2.

(6) Remove the resistive load from pins 16 and 17. Check to see that continuity does not exist between these pins. If continuity is indicated check for a shorted capacitor (C16).



Functional Block Diagram

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1172A		TLN8761A		LINE DRIVER BOARD
		TLN8762A		LINE DRIVER MODULE

NOTES:

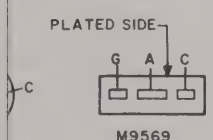
1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000)
   CAPACITOR VALUES ARE IN MICROFARADS
2. AT POINTS SHOWING TWO VOLTAGE READINGS THE TOP VALUE (IN PARENTHESIS) IS FOR THE TRANSMIT CONDITION AND THE BOTTOM VALUE IS FOR THE RECEIVE OR STANDBY CONDITIONS.
3. THE "AMP LEVEL" JUMPER CONNECTS TO ONE OF THE THREE POINTS [-8] [0] OR [+18] TO SELECT DESIRED INTERCOM TALK LEVEL.
4. JUMPER TABLE (FOR DC AND TONE REMOTES).

APPLICATION	JU1	JU2	JU3	JU4
BASE STATION WITH ONE RECEIVER: 2-WIRE AUDIO	OUT	IN	IN	IN
BASE STATION WITH TWO RECEIVERS: 2-WIRE AUDIO	IN *	IN	IN	IN
BASE STATION WITH ONE RECEIVER: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE STATION WITH ONE RECEIVER: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATION WITH TWO RECEIVERS: 4-WIRE AUDIO, BOTH RECEIVERS ON SAME LINE (LINE DRIVER MODULE)	IN *	OUT	IN	OUT
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; BOTH RECEIVERS ON SAME LINE (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (LINE DRIVER MODULE)	OUT	OUT **	IN	OUT **
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (4-WIRE AUDIO MODULE)	IN	IN *	OUT	IN *
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE (RA) STATION 2-WIRE AUDIO	OUT	IN	IN	IN
BASE (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
REPEATER (RA) STATION: 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN

*OUT IN TOME REMOTE STATIONS.
**IN ON TONE REMOTE STATIONS.

EPS-1737-A

MPER CONNECTS
E THREE
0, OR -8.

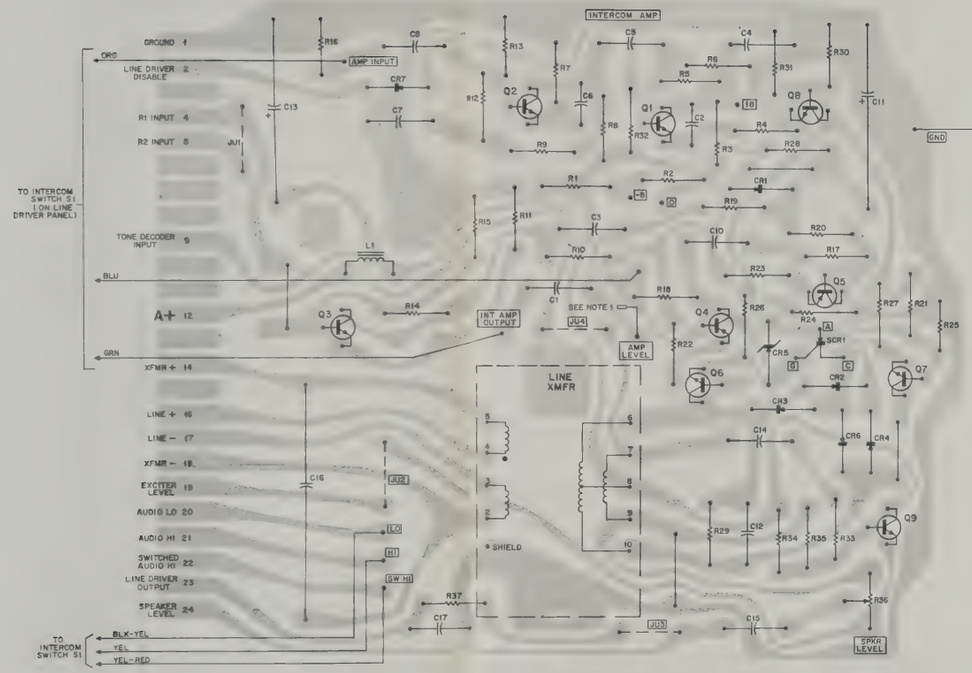


M9569

LINE DRIVER MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

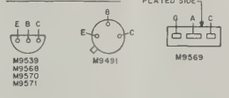
TLN1172A Line Driver Module
Or 4-Wire Audio Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E43-A
12/12/69-AP

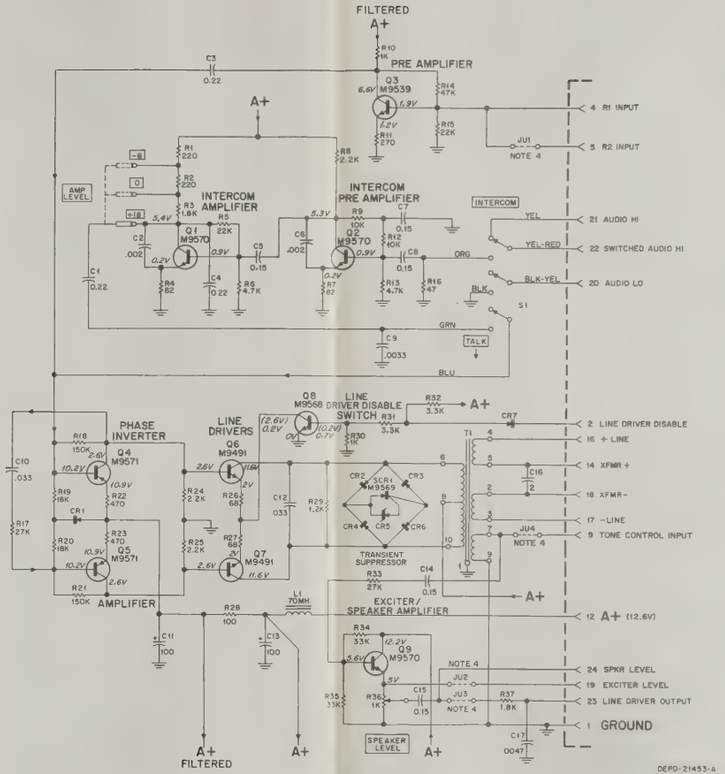


OL-DEPS-479-0

NOTE:
1. AMP LEVEL JUMPER CONNECTS TO ONE OF THE THREE POINTS: +B, O, OR −B.

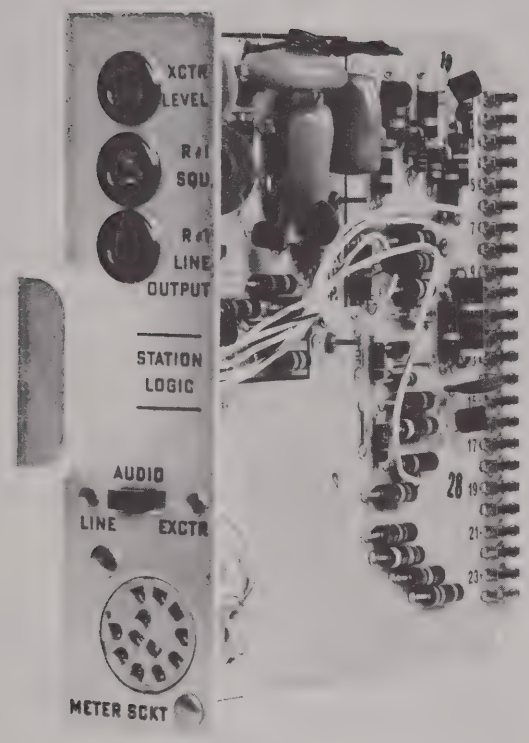
TRANSISTOR DETAILS:





STATION LOGIC MODULE

MODEL TLN1173A



1. DESCRIPTION

The TLN1173A Station Logic Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnect board of the remote control chassis.

2. FUNCTIONS

This module contains the Line Output, Squelch, and Exciter Level controls. It exercises push-to-talk control over other station functions from local or line push-to-talk commands. It also switches the antenna relay, for channel element turn-on and activates the power supply for the transmit mode. On command, a ground is connected for operating the antenna relay and for muting the receiver.

3. CIRCUIT DESCRIPTION

a. Control Functions

A signal from the receiver discriminator, entering the module on pin 19, is routed to the receiver squelch circuit through the R#1 SQUELCH control and pin 21. The signal also passes through the R#1 LINE OUTPUT control to pin 23 for amplification in the receiver audio stages when the receiver is unsquelched.

b. Audio Functions

An audio signal entering the module on pin 4 passes through capacitor C1 into the XCTR LEVEL control and into Paraphase Amplifier Q1. For the line levels below 0 dbm, JU2 is installed. If the level is above 0 dbm, JU2 is not used. From the collector of Q1, the amplified signal is sent to Exciter Audio Amplifier Q2 for further amplification and out the transmitter exciter audio input.

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PARTS LIST

TLN8761A Line Driver Board — PL-253-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; unl stated
C1, 3, 4	8D82905G11	.22; 50 v
C2, 6	21D82428B25	.002 ±20%; 500 v
C5, 7, 8, 14, 15	8D82905G05	0.15; 50 v
C10, 12	8D82905G08	.033; 50 v
C11, 13	23D82601A25	100 +150-10%; 20 v
C16	8D82045F05	2; 350 v
C17, 33	8D82905G26	.0047; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 7	48C82392B03	silicon; RD1343
CR2, 3, 4, 6	48C82466H01	silicon
CR5	48D82256C20	zener type; 27 v
		COIL, choke:
L1	25B82878A03	70 mH
		TRANSISTOR: (SEE NOTE)
Q1, 2, 9	48R869570	N-P-N; M9570
Q3	48R869539	N-P-N; M9539
Q4, 5	48R869471	P-N-P; M9471
Q6, 7	48R869491	N-P-N; M9491
Q8	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 w;
R1, 2	6S127800	220
R3, 37	6S129269	1.8K
R4, 7	6S129224	82
R5, 15	6S128685	22K
R6, 13	6S127804	4.7K
R8,	6S128689	2.2K
R9, 12	6S129225	10K
R10, 30	6S127802	1K
R11	6S129752	270
R14	6S128902	47K
R16	6S129233	47
R17, 33	6S127806	27K
R18, 21	6S128683	150K ±5%
R19, 20	6S131526	18K ±5%
R22, 23	6S127801	470
R24, 25	6S129804	2.2K ±5%
R26, 27	6S129861	68
R28	6S129753	100
R29	6S129235	1.2K
R31, 32	6S129231	3.3K
R34, 35	6S127807	33K
R36	18C83083G04	variable: 1K ±30%
		RECTIFIER:
SCR1	48R869569	silicon controlled; M9569
		TRANSFORMER, line-driver:
T1	25C83000H01	pri: No. 1; term. 2 & 3; 150 ohms; No. 2; term. 4 & 5; 150 ohms; sec; No. 1; term. 6 & 10 w/8 tap; total res. 1.2K ohms; No. 2; term. 7 & 9; 600 ohms
NON-REFERENCED ITEMS		
	9B83011H01	RECEPTACLE, board mtg: 17 req'd.
	9A83445D01	PIN, terminal: 3 req'd.

TLN8762A Line Driver Panel — PL-354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C9	21D82428B10	CAPACITOR, fixed: .0033 uF ±10%; 100 v
S1	40B83881C01	SWITCH, slide: 3 pdt
NON-REFERENCED ITEMS		
	1V80781A47	PANEL ASSY. (riveted) incl. ref. part S1
	43B82721C01	BUSHING, insulator
	45B83914G01	GUIDE, printed circuit board
	46B83284H01	PLUG, keying

PARTS LIST

TLN8761A Line Driver Board — PL-253-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; unl stated
C1, 3, 4	8D82905G11	.22; 50 v
C2, 6	21D82428B25	.002 ±20%; 500 v
C5, 7, 8, 14, 15	8D82905G05	0.15; 50 v
C10, 12	8D82905G08	.033; 50 v
C11, 13	23D82601A25	100 +150-10%; 20 v
C16	8D82045F05	2; 350 v
C17, 33	8D82905G26	.0047; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 7	48C82392B03	silicon; RD1343
CR2, 3, 4, 6	48C82466H01	silicon
CR5	48D82256C20	zener type; 27 v
		COIL, choke:
L1	25B82878A03	70 mH
		TRANSISTOR: (SEE NOTE)
Q1, 2, 9	48R869570	N-P-N; M9570
Q3	48R869539	N-P-N; M9539
Q4, 5	48R869471	P-N-P; M9471
Q6, 7	48R869491	N-P-N; M9491
Q8	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 w;
R1, 2	6S127800	220
R3, 37	6S129269	1.8K
R4, 7	6S129224	82
R5, 15	6S128685	22K
R6, 13	6S127804	4.7K
R8,	6S128689	2.2K
R9, 12	6S129225	10K
R10, 30	6S127802	1K
R11	6S129752	270
R14	6S128902	47K
R16	6S129233	47
R17, 33	6S127806	27K
R18, 21	6S128683	150K ±5%
R19, 20	6S131526	18K ±5%
R22, 23	6S127801	470
R24, 25	6S129804	2.2K ±5%
R26, 27	6S129861	68
R28	6S129753	100
R29	6S129235	1.2K
R31, 32	6S129231	3.3K
R34, 35	6S127807	33K
R36	18C83083G04	variable: 1K ±30%
		RECTIFIER:
SCR1	48R869569	silicon controlled; M9569
		TRANSFORMER, line-driver:
T1	25C83000H01	pri: No. 1; term. 2 & 3; 150 ohms; No. 2; term. 4 & 5; 150 ohms; sec; No. 1; term. 6 & 10 w/8 tap; total res. 1.2K ohms; No. 2; term. 7 & 9; 600 ohms
NON-REFERENCED ITEMS		
	9B83011H01	RECEPTACLE, board mtg: 17 req'd.
	9A83445D01	PIN, terminal: 3 req'd.

TLN8762A Line Driver Panel — PL-354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C9	21D82428B10	CAPACITOR, fixed: .0033 uF ±10%; 100 v
S1	40B83881C01	SWITCH, slide: 3 pdt
NON-REFERENCED ITEMS		
	1V80781A47	PANEL ASSY. (riveted) incl. ref. part S1
	43B82721C01	BUSHING, insulator
	45B83914G01	GUIDE, printed circuit board
	46B83284H01	PLUG, keying

The Repeater Level control (external to the module) is connected to the circuit through pin 5 at diode CR1. When a high-resistance path appears at pin 5, CR1 is reverse-biased, and the audio path from pin 4 is through amplifier Q1 as previously described. When the path at pin 5 becomes a low resistance, diode CR1 becomes forward-biased and gates the signal around Paraphase Amplifier Q1. The signal then feeds into Exciter Audio Amplifier Q2 as before.

The Local Mic Audio Switch is normally conducting to provide a ground for local microphone audio. Whenever line push-to-talk occurs, Q3 is cut off, removing the local microphone audio ground path. This cutoff gives line audio priority over local microphone audio signals.

c. Circuit Control Functions

When a local or line push-to-talk input is applied to pin 10 or 14, it is applied to the base of P-T-T Inverter, Q4. The "low" input is changed to a "high" level in the inverter, then applied to the Antenna Relay and Mute Switch.

In "Private-Line" applications, push-to-talk release is delayed at the end of a transmission by an input to pin 13 from the external "Private-Line" reverse-burst circuitry. This input holds the P-T-T circuit operated for the duration of the reverse-burst tone.

When a "high" from the P-T-T Inverter is received at the Antenna Relay and Mute Switch, a "low" at its output mutes receiver No. 1 and operates the antenna relay switch, audio disable, and line driver disable circuits.

In repeater applications, a ground appears at pin 7, which prevents Mute Switch Q6 from operating. This allows the receiver in the repeater to remain operational for retransmission of the received signal.

The P-T-T Inverter controls the switched A+. Switched A+ is applied after a 35-millisecond delay to allow the antenna relay to switch to the transmit position before the rf power is applied. A+ from the external redundancy circuit must also be present through pin 9 for switched A+ to be present. When the redundancy input is present, and the switched A+ is turned on by the P-T-T Inverter, the external transmitter circuits are energized to produce an rf output.

In repeater applications without wire-line control, jumper JU1 is used and switched A+ is provided without the redundancy input previously described.

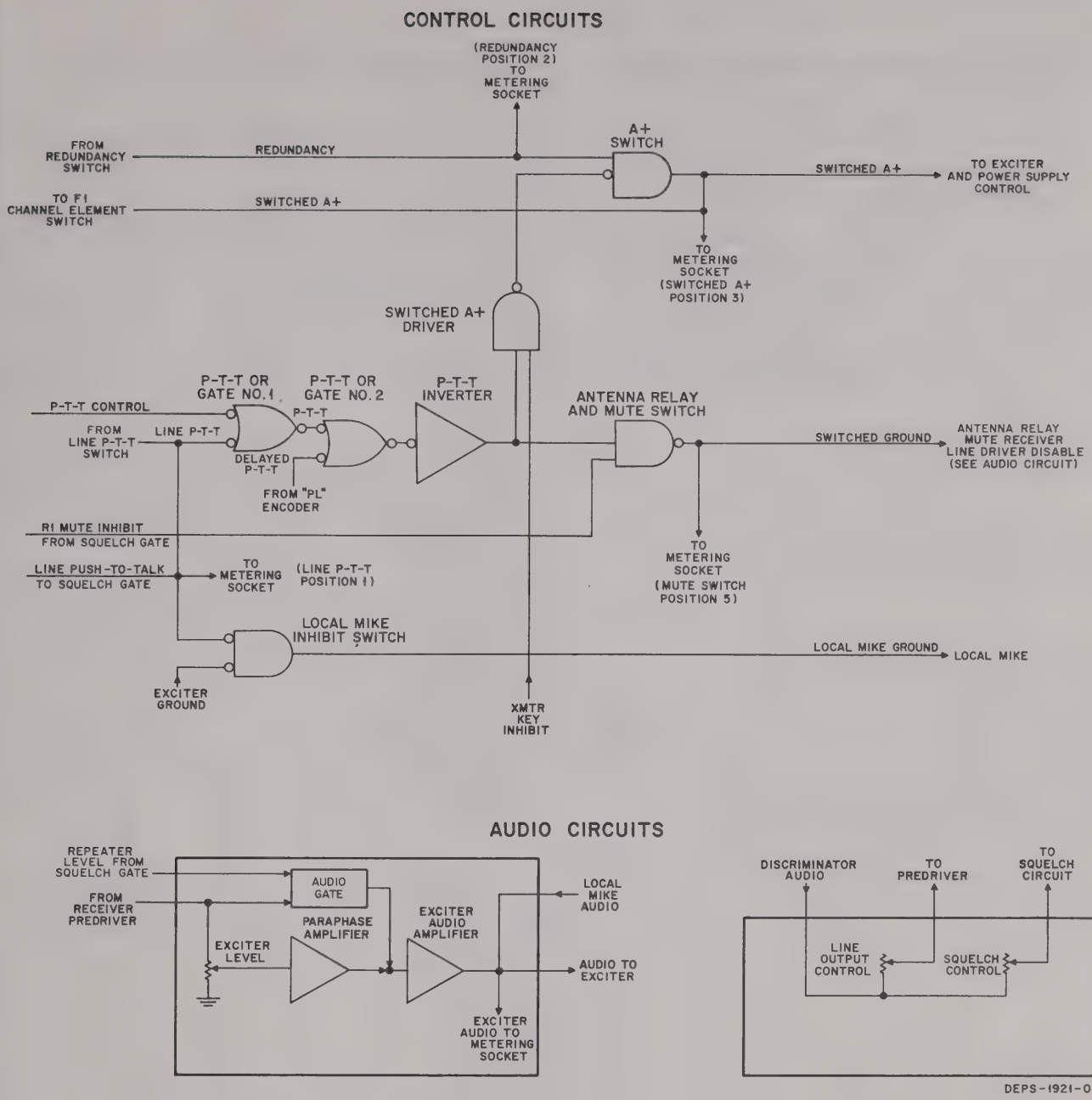
When the time-out timer reaches the end of its cycle, the Transmitter Key Inhibit (through pin 8 on the module) removes the switched A+.

d. Metering Facilities

A receptacle is provided on the module front panel for metering of the functions available at the module. The functions metered and their corresponding Motorola Test Set positions are given in the following table:

Function	Test Set Meter Position	Typical Reading (UA)	
		Standby	Transmit
Exciter Audio Level	11 (Note 1)	As required	
Line Audio Level	11 (Note 2)	As required	
Line Push-To-Talk Logic	1	25 min	0
Switched A+ Logic	3	0	25 min
Redundancy Logic	2	0 (Note 4)	25 min
Receiver Mute Switching Logic	5	12	0
"Private-Line" Disable Logic	6	12 (Note 3)	12 (Note 3)

NOTES:
1. With Module switch in EXCTR position.
2. With Module switch in LINE position.
3. 2 uA in community repeaters.
4. 25 min. in tone remote control applications.



Functional Block Diagram

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access, remove the module, insert the Model TKN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 11, 24	Ground
4	Audio oscillator through 0.1 uF
1, 2, 9	+12 volts dc
16	AC Voltmeter to ground
2	10K ohms to 12 volts dc
4	10K ohms to 12 volts dc
6	10K ohms to ground
NOTE: Temporarily connect JU1 for out-of-chassis servicing.	

b. Module Malfunction Location Techniques

(1) Connect voltage and signal sources to the module as indicated in the preceding table.

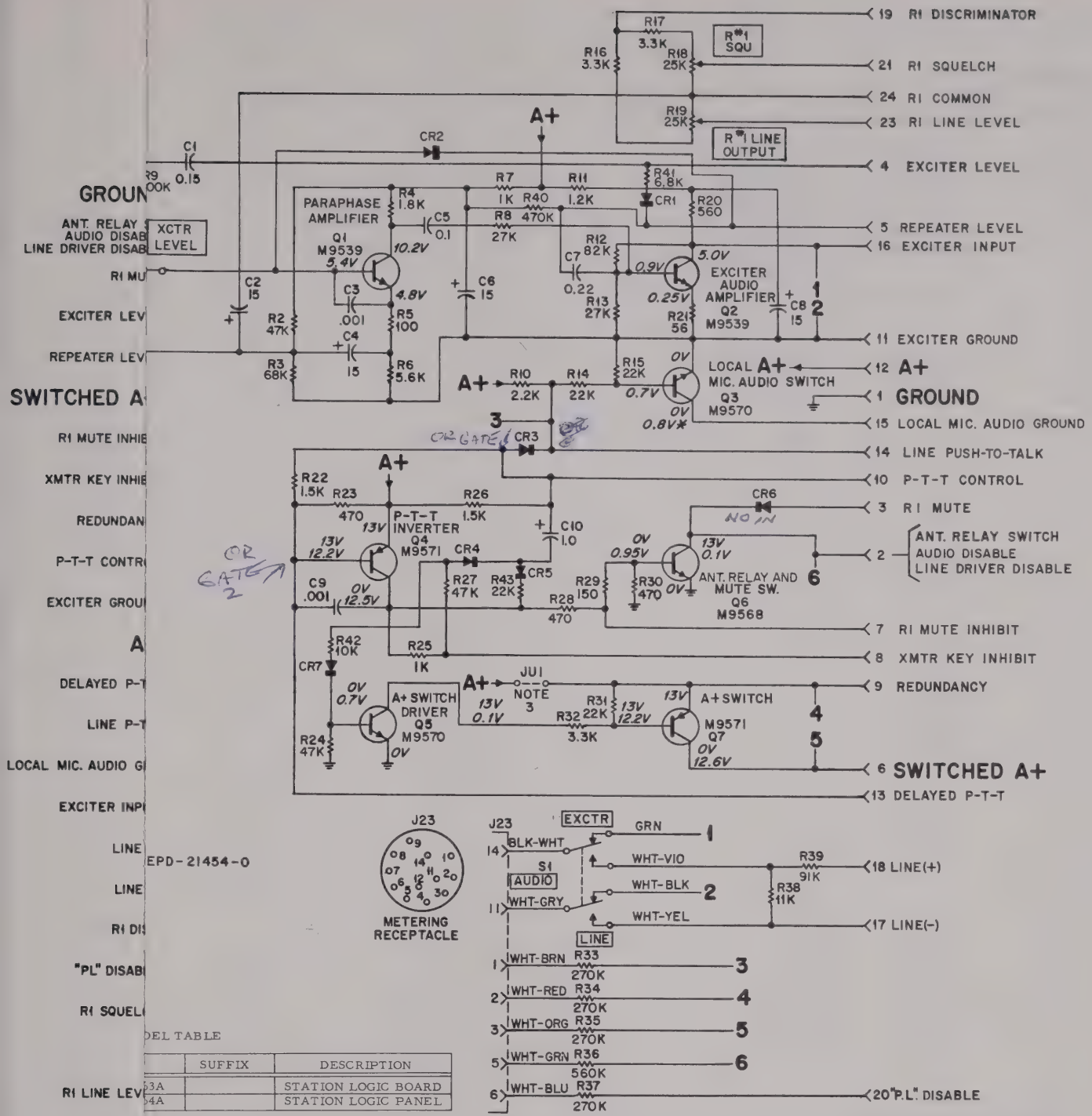
(2) Adjust the audio oscillator output for -25 dbm at pin 4. With this input, the level at pin 16 should measure approximately -10 dbm with JU2 connected. If this level cannot be achieved, check stages Q1 and Q2. If the level is correct, ground pin 5. The reading at pin 16 should fall to zero. If this does not occur, check diode CR1 and resistor R41.

(3) Ground pin 14. With a dc voltmeter, measure the voltage at pins 6 and 15. Each should read +12 volts. The voltage measured at pin 2 should read zero.

Refer to the schematic diagram. If a voltage or ground does not appear at the prescribed location, check each stage, in turn, that feeds into the pin indicating the malfunction.

(4) With pin 14 grounded, ground pin 8. With a dc voltmeter, look for +12 volts dc at pin 2 and ground at pin 6. If these are present, the Antenna Relay and Mute Switch, A+ Switch Driver, and A+ Switch are functioning properly.

(5) With pin 14 grounded, unground pin 8 and ground pin 7. Pin 2 should read +12 volts dc and pin 6 should read +12 volts dc.



EPD-21454-0

DEL TABLE

	SUFFIX	DESCRIPTION
3A		STATION LOGIC BOARD
4A		STATION LOGIC PANEL

MS (K=1000).
MICROFARADS.
LINE P-T-T IS GROUNDED WHERE TWO
POINT:

	DC CONTROL JU1	TONE CONTROL
	OUT	IN
	IN	IN
HOUT	IN	IN
H WIRE	OUT	IN
	IN	IN
	IN	IN

HE TRANSMIT AUDIO LEVEL FROM THE
DBM OR GREATER AS MEASURED AT THE
PER IF THIS LEVEL IS BELOW 0 DBM.

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLN1173A Station Logic Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E44-A
12/12/69-AP

STATION LOGIC MODULE

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access, remove the module, insert the Model TKN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 11, 24	Ground
4	Audio oscillator through 0.1 uF
1, 2, 9	+12 volts dc
16	AC Voltmeter to ground
2	10K ohms to 12 volts dc
4	10K ohms to 12 volts dc
6	10K ohms to ground
NOTE: Temporarily connect JU1 for out-of-chassis servicing.	

b. Module Malfunction Location Techniques

(1) Connect voltage and signal sources to the module as indicated in the preceding table.

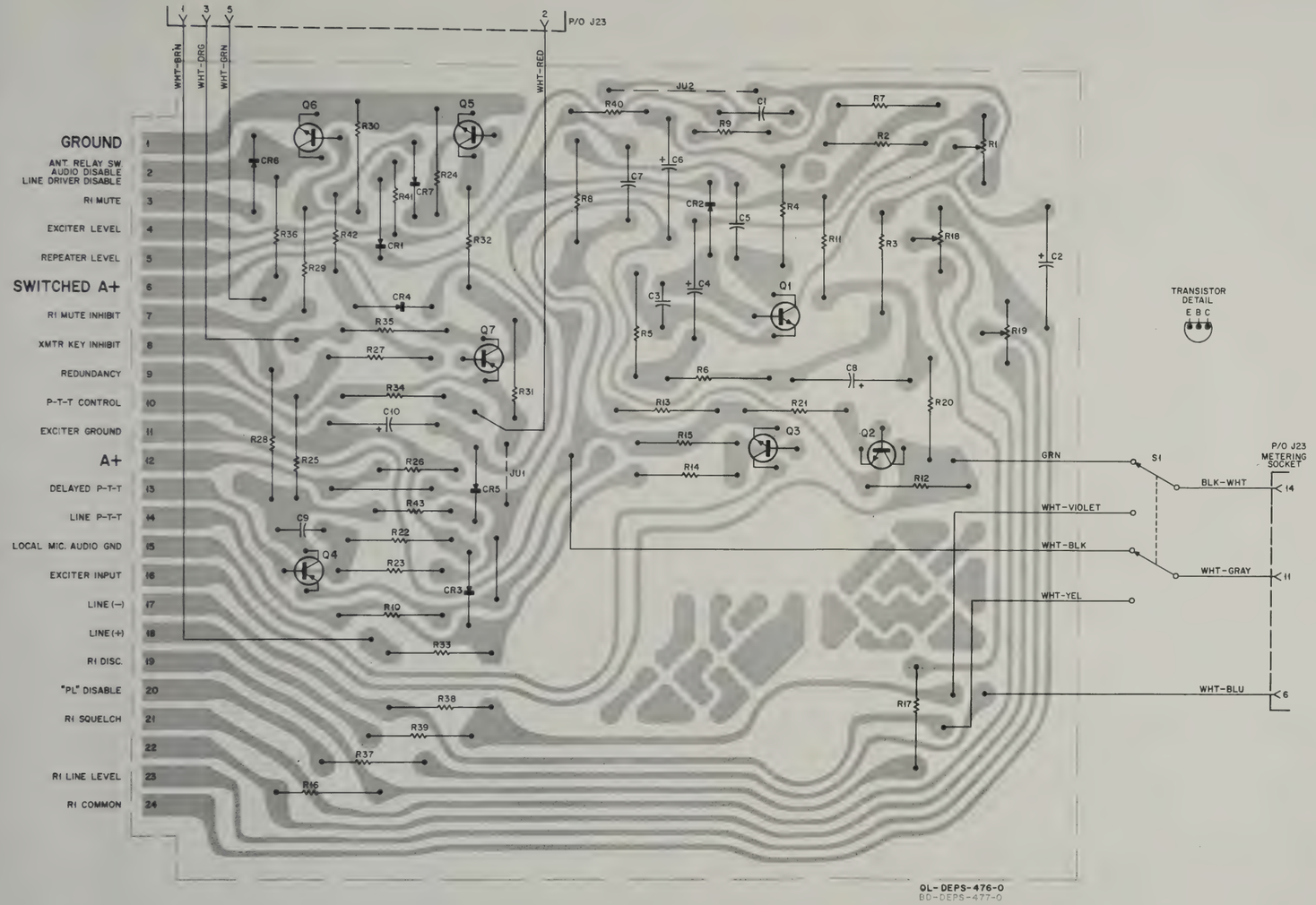
(2) Adjust the audio oscillator output for -25 dbm at pin 4. With this input, the level at pin 16 should measure approximately -10 dbm with JU2 connected. If this level cannot be achieved, check stages Q1 and Q2. If the level is correct, ground pin 5. The reading at pin 16 should fall to zero. If this does not occur, check diode CR1 and resistor R41.

(3) Ground pin 14. With a dc voltmeter, measure the voltage at pins 6 and 15. Each should read +12 volts. The voltage measured at pin 2 should read zero.

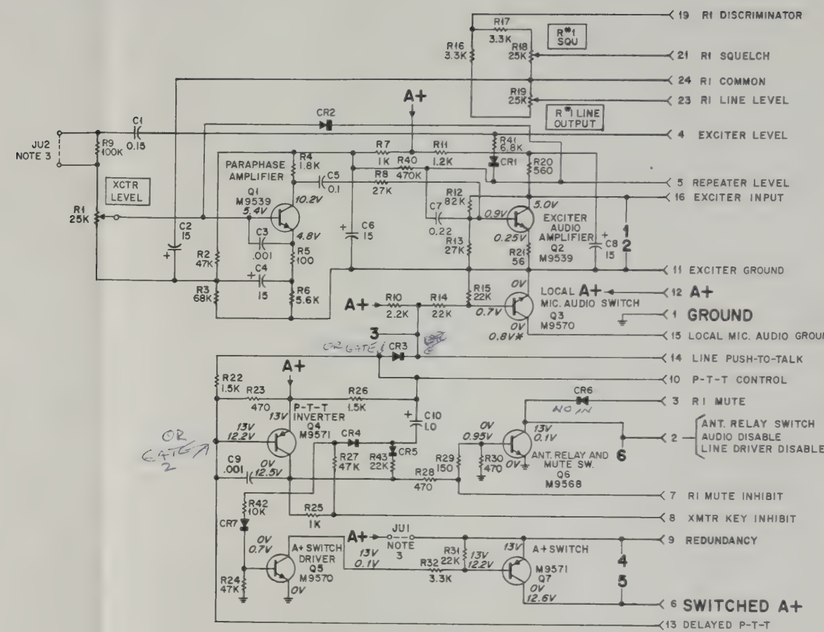
Refer to the schematic diagram. If a voltage or ground does not appear at the prescribed location, check each stage, in turn, that feeds into the pin indicating the malfunction.

(4) With pin 14 grounded, ground pin 8. With a dc voltmeter, look for +12 volts dc at pin 2 and ground at pin 6. If these are present, the Antenna Relay and Mute Switch, A+ Switch Driver, and A+ Switch are functioning properly.

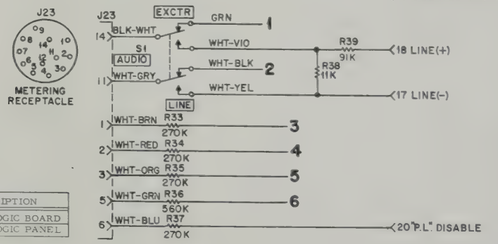
(5) With pin 14 grounded, unground pin 8 and ground pin 7. Pin 2 should read +12 volts dc and pin 6 should read +12 volts dc.



OL-DEPS-476-O
BD-DEPS-477-O



CEPD-21454-O



MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1173A		TLN8763A		STATION LOGIC BOARD
		TLN8764A		STATION LOGIC PANEL

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000).
   CAPACITOR VALUES ARE IN MICROFARADS.
2. * INDICATES VOLTAGES WHEN LINE P-T-T IS GROUNDED WHERE TWO VOLTAGES ARE GIVEN AT ONE POINT:
   UPPER VOLTAGE = RECEIVE
   LOWER VOLTAGE = TRANSMIT
3. JUMPER TABLE

APPLICATION	DC CONTROL JU1	TONE CONTROL
BASE STATION	OUT	IN
BASE (RA) STATION	IN	IN
REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	IN	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL	OUT	IN
REPEATER (RA) STATION	IN	IN
COMMUNITY REPEATER (RT)	IN	IN

4. REMOVE JUMPER JU2 WHEN THE TRANSMIT AUDIO LEVEL FROM THE REMOTE CONTROL POINT IS 0 DBM OR GREATER AS MEASURED AT THE STATION, CONNECT THE JUMPER IF THIS LEVEL IS BELOW 0 DBM.

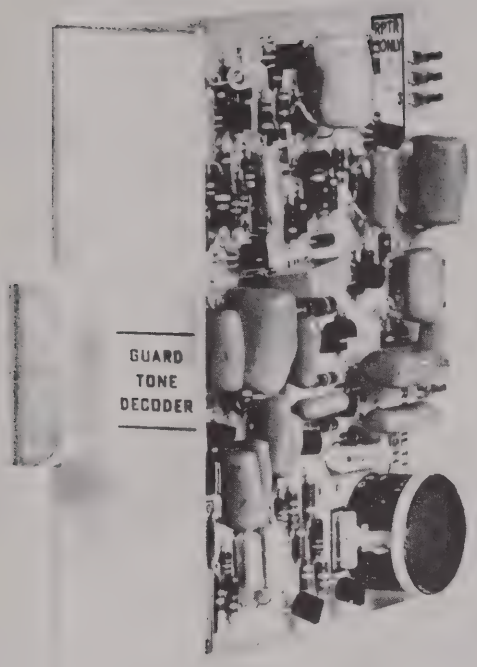
EPS-1028-A

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1173A Station Logic Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E44-A
12/12/69-AP

GUARD TONE DECODER

MODEL TLN1245A



1. DESCRIPTION

The TLN1245A Guard Tone Decoder is a fully transistorized, plug-in circuit module for the tone remote control chassis of Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTION

The guard tone decoder serves to convert a 2175 Hz guard tone signal received from a remote control source to a line push-to-talk voltage. The decoder also amplifies and distributes received function tones to other function decoders.

3. CIRCUIT DESCRIPTION

A high-level 125-millisecond burst of guard tone from a remote control point will enter the module on pin 9. The prefilter (L1-C2) through which it passes provides selectivity and protection against undesired signals and noise. Passing through Q1, Q2 and Q3, it is amplified and applied to transistor Q4, the "Vibrasponder" resonant reed driver. The "Vibrasponder" reed passes only 2175 Hz signals. The initial burst of guard tone is then further amplified by Q5 and Q6. Transistor Q6 drives Q11, connected as a peak detector, which changes the guard tone to approximately 11.4 volts dc. This dc voltage drives the push-to-talk switch, transistor Q13, through Q12. When push-to-talk occurs, the bootstrap transistor Q15, is turned off, which raises the gain of the tone decoder module 30 dB, producing a "snap" action push-to-talk function. At the same time, a large negative-going transient voltage, which resulted from the push-to-talk function, turns off transistors Q16 and Q17, switching the prefilter network out of the circuit so that all associated function decoders may receive function tones.

During the time the preceding has been taking place, the activity checker, Q20, is holding transistor Q18 in the "off" state because it is receiving line signals. With Q18 off, the guard tone detector (Q11) is operational. All of the preceding events have occurred in approximately 50 milliseconds.

The system is now ready to receive function tones. At the end of the initial guard tone burst

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ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

PARTS LIST

TLN8763A Station Logic Circuit Board — PL-285-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	8D82905G05	0.15 uF ±10% 50 v
C2, 4, 6, 8	23K865136	15 uF ±20%; 25 v
C3, 9	21D82187B20	.001 uF ±10%; 100 v
C5	8D82905G07	0.1 uF ±10%; 50 v
C7	8D82905G11	0.22 uF ±10%; 50 v
C10	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon; RD1343
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R869539	N-P-N; M9539
Q3, 5	48R869570	N-P-N; M9570
Q4, 7	48R869571	P-N-P; M9571
Q6	48R869568	N-P-N; M9568
		RESISTOR, fixed; ±10%; 1/2 w; unl stated
R1, 18, 19	18C83083G03	variable; 25K
R2, 27	6S6048	47K
R3	6S6074	68K
R4	6S2089	1.8K
R5	6S6326	100
R6	6S6117	5.6K
R7, 25	6S6229	1K
R8, 13	6S6434	27K
R9	6S129226	100K; 1/4 w
R10	6S6069	2.2K; 1/4 w
R11	6S6393	1.2K
R12	6S5644	82K
R14, 15, 31	6S6397	22K
R16, 17, 32	6S5581	3.3K
R20	6S6291	560
R21	6S5614	56
R22	6S6038	1.5K
R23, 30	6S6090	470
R24	6S5591	18K
R26	6S127803	1.5K; 1/4 w
R29	6S6373	150
R28	6S5772	470; 1 w
R33, 34, 35, 37	6S2050	270K ±5%
R36	6S5796	560K ±5%
R38	6S115017	11K ±5%
R39	6S5789	91K ±5%
R40	6S129148	470K; 1/4 w
R41	6S128687	6.8K; 1/4 w
R42	6S129225	10K; 1/4 w
R43	6S128685	22K; 1/4 w

TLN8764A Station Logic Panel — PL-286-O

		CONNECTOR, receptacle:
J23	9C83478E01	female; 12 contact
		SWITCH, slide:
S1	40B83204B01	dpdt

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

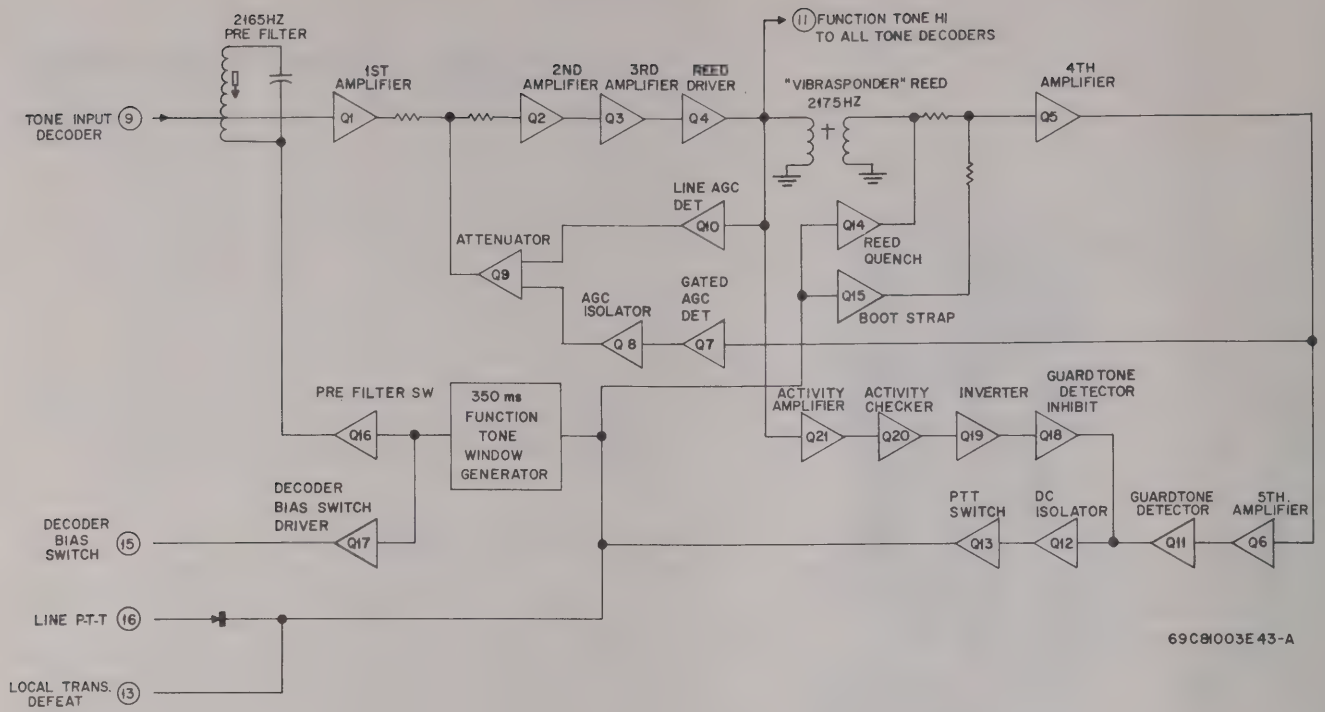
TLN8763A Station Logic Circuit Board — PL-285-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	8D82905G05	0.15 uF ±10% 50 v
C2, 4, 6, 8	23K865136	15 uF ±20%; 25 v
C3, 9	21D82187B20	.001 uF ±10%; 100 v
C5	8D82905G07	0.1 uF ±10%; 50 v
C7	8D82905G11	0.22 uF ±10%; 50 v
C10	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon; RD1343
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R869539	N-P-N; M9539
Q3, 5	48R869570	N-P-N; M9570
Q4, 7	48R869571	P-N-P; M9571
Q6	48R869568	N-P-N; M9568
		RESISTOR, fixed; ±10%; 1/2 w; unl stated
R1, 18, 19	18C83083G03	variable; 25K
R2, 27	6S6048	47K
R3	6S6074	68K
R4	6S2089	1.8K
R5	6S6326	100
R6	6S6117	5.6K
R7, 25	6S6229	1K
R8, 13	6S6434	27K
R9	6S129226	100K; 1/4 w
R10	6S6069	2.2K; 1/4 w
R11	6S6393	1.2K
R12	6S5644	82K
R14, 15, 31	6S6397	22K
R16, 17, 32	6S5581	3.3K
R20	6S6291	560
R21	6S5614	56
R22	6S6038	1.5K
R23, 30	6S6090	470
R24	6S5591	18K
R26	6S127803	1.5K; 1/4 w
R29	6S6373	150
R28	6S5772	470; 1 w
R33, 34, 35, 37	6S2050	270K ±5%
R36	6S5796	560K ±5%
R38	6S115017	11K ±5%
R39	6S5789	91K ±5%
R40	6S129148	470K; 1/4 w
R41	6S128687	6.8K; 1/4 w
R42	6S129225	10K; 1/4 w
R43	6S128685	22K; 1/4 w

TLN8764A Station Logic Panel — PL-286-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle:
J23	9C83478E01	female; 12 contact
		SWITCH, slide:
S1	40B83204B01	dpdt

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

(125 milliseconds), a 40-millisecond function tone is sent by the remote control unit, amplified by the guard tone decoder transistors (Q1, Q2, Q3, and Q4) and then distributed to all function decoders. If a transmission is in progress, the guard tone resumes and continues to drive transistor Q11, providing push-to-talk activation for the rest of the transmission. This guard tone level is 30 dB lower than the initial burst, but still provides full drive to transistor Q11, because Q15 is "off", and inserts 30 dB additional gain.

At the end of the transmission, the activity checker (Q20) ceases to receive audio signals, so it turns on transistor Q18, which turns off the unit in less than 100 milliseconds.

The Line AGC Detector (Q10) and Attenuator (Q9) stages reduce the module gain upon receipt of very strong audio signals to prevent the third amplifier stage (Q3) from clipping, which would produce harmonics that could drive the "Vibrasponder" resonant reed. The Gated AGC Detector is very slow operating, and assures proper drive to the detector stage (Q11) and activity checker (Q20) with any line loss from 0 to 30 dB.

The reed quenching circuit is activated only when push-to-talk ceases, and disables the "Vibrasponder" resonant reed for about 100 milliseconds. This quenching action is necessary because the output from the "Vibrasponder" reed decays very slowly because of its inherent high "Q".

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module out of the Chassis

If the module is to be serviced without connection to its associated remote control

chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 17	Ground
9	Audio Oscillator through .1 uF
11	AC Voltmeter
12	A+ 13.6 volts dc

c. Normal Conditions

The following chart tabulates normal levels and values for proper operation of the guard tone decoder module. Excessive deviations from these values indicate abnormal conditions.

FUNCTION	TYPICAL VALUE
Pull-In Line Level @ 2175 Hz	-41 dBm
Drop-Out Line Level @ 2175 Hz	-61 dBm
P-T-T Turn-On Time	Less Than 100 milliseconds
P-T-T Turn-Off Time	Less Than 100 milliseconds
Prefilter Switch Time	375 milliseconds
Gated AGC Threshold	-55 dBm
Line AGC Threshold	-28 dBm
Prefilter Frequency	2165 Hz
"Vibrasponder" Frequency	2175 Hz

d. Module Malfunction Location Techniques

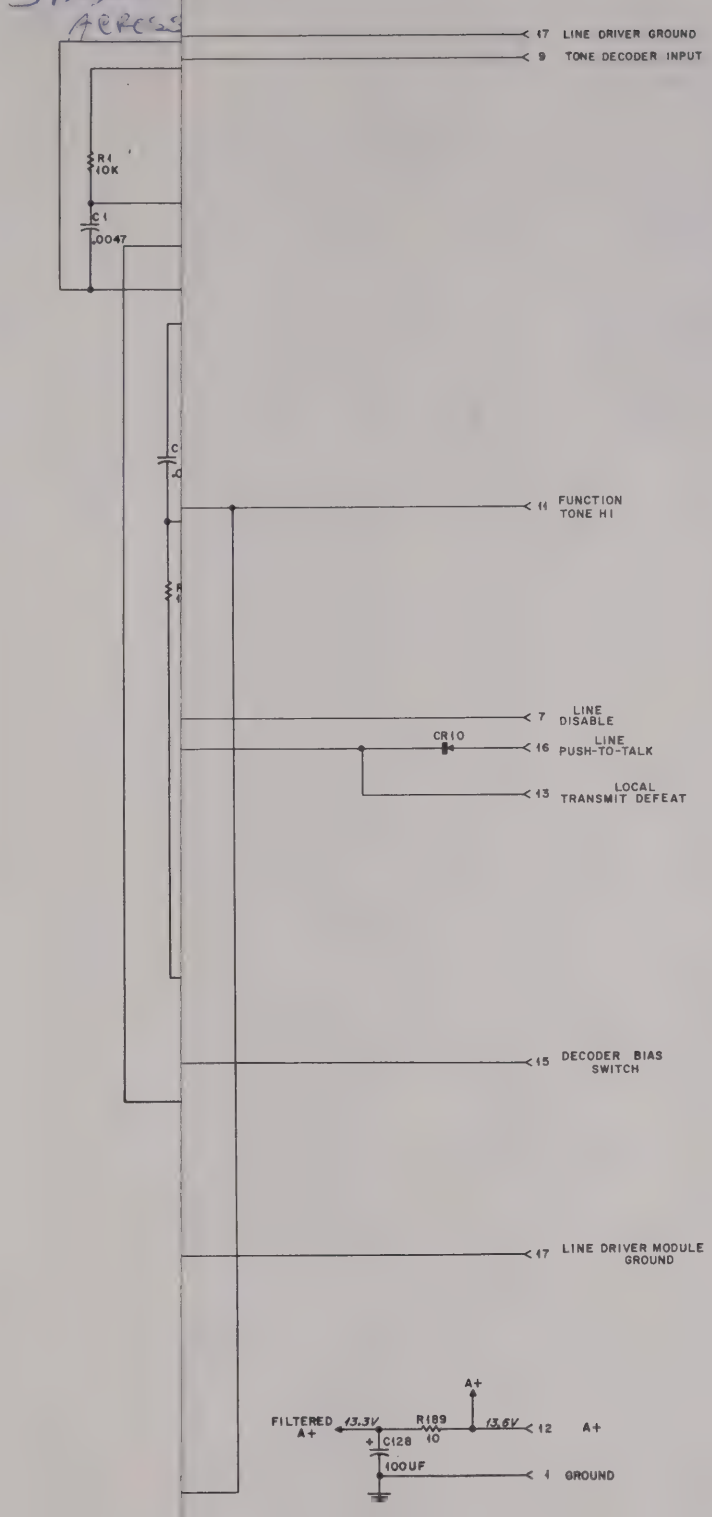
(1) Inject a 15-millivolt, 2175 Hz audio tone into pin 9.

(2) Measure the dc voltage from pin 13 to ground. As the tone input voltage reaches 15 millivolts, pin 13 should go to ground. If the ground does not occur, check voltages on transistors Q1 through Q6, Q11, Q12 and Q13.

(3) Connect an ac voltmeter across pin 11 and ground, and a dc voltmeter to pin 13 and ground. With an accurate 2175 Hz tone injected at pin 9, pin 13 should go to ground, and remain. When pin 13 is at ground, the output level at pin 11 should remain constant at 180 millivolts ±3 dB when the input level is slowly varied from 3 millivolts to 80 millivolts. If this does not occur, check Q1, Q2, Q3, Q4, and Q5, Q7, Q8, Q9.

(4) Ground the base of the Q16 prefilter switch. With the ac voltmeter connected to pin 11, inject a 2000 Hz tone into pin 9. As the input level is raised to 40 millivolts ±3 dB, the level measured at pin 11 should reach approximately 3 volts ac and then level off. With proper operation, increasing the input at pin 9 to 4 volts ac should cause only a 2 dB increase in the level at pin 11 from that with the 40 millivolt input. IF STEP 3 WAS OK AND STEP 4 DID NOT OPERATE, CHECK Q10.

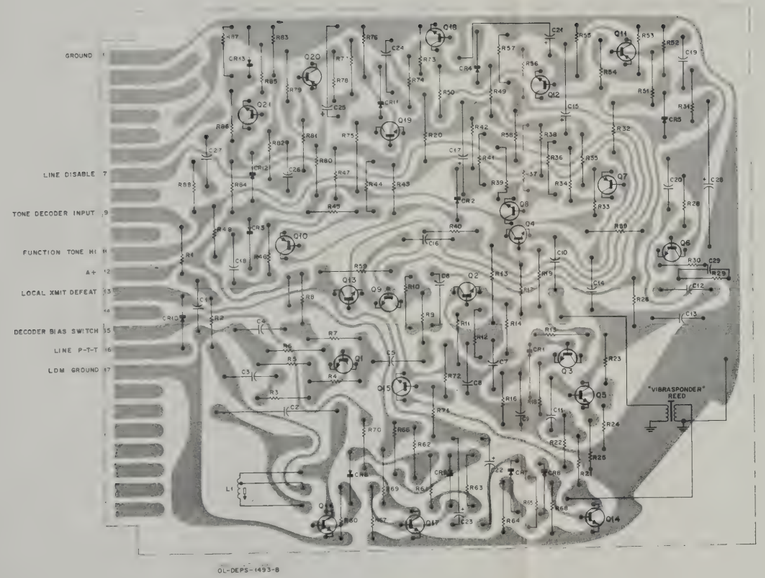
(5) Repeat steps (1) and (2) with an accurate 2175 Hz tone. To check the drop-out level, slowly reduce the input at pin 9 until the voltage at pin 13 goes to the A+ level. Measure the ac voltage at pin 9. An extra attenuator may be required, since the dropout level is typically less than -60 dBm (1 mV).

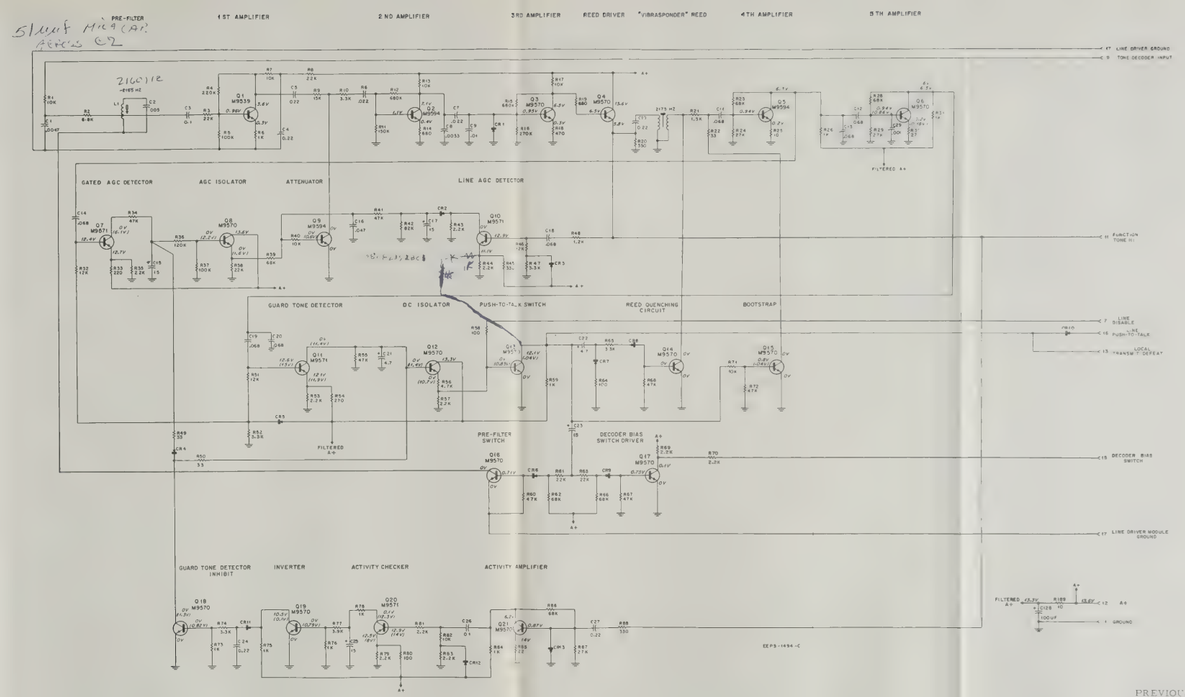


GUARD TONE DECODER MODULE

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram & Circuit Board Detail
Motorola No. 63P81004E92-B
1/2/70-UP





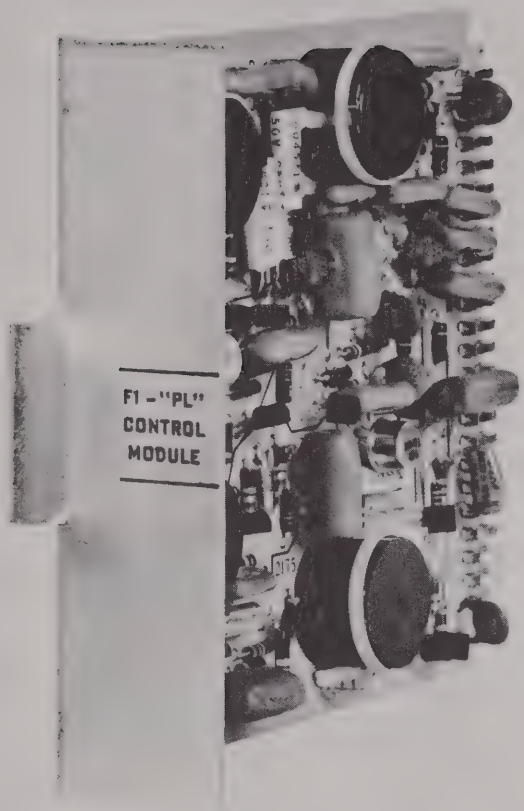
PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram & Circuit Board Detail
Motorola No. 63P81004E92-B
1/2/70-UP

GUARD TONE DECODER MODULE

F1-"PRIVATE-LINE" DISABLE CONTROL MODULE

MODEL TLN1244A



1. DESCRIPTION

The TLN1244A F1-"PL" Disable Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

The module converts the proper tone signal from a remote control source to a grounding function to turn on a transmitter channel element for frequency F1, or to disable the "Private-Line" operation of the receiver for channel monitoring before transmitting. The function is selected by the frequency of the received control tone.

3. CIRCUIT DESCRIPTION

In the quiescent state, all function detectors are reverse-biased and cannot be turned on. When line push-to-talk occurs, power is applied to the F1 Bistable Multivibrator, Q3 and Q4, by the line Control Priority Gate, Q5 and Q6. The Bias Switch, Q7, sets the operating bias on the F1 Detector, Q2, and the "PL" Disable Detector Q8, and all other function detectors connected in other modules for about 375 milliseconds during line push-to-talk. Normally, the detectors are back-biased and cannot be turned on. A function tone entering on pin 14 passes through the Function Tone Amplifier, Q1, operating at about a +16 dBm clipping level, which assures adequate drive to the detector stages.

When a 1950 Hz tone is received, it passes through the L1 and C4 network and into the F1 detector stage, Q2. When the tone is detected, it causes the F1 Bistable Multivibrator to change state, grounding the transmitter channel element via pin 3. Concurrently, the receiver is returned to its "Private-Line" mode when the transmitter

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 W. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

REVISIONS

63P81004E92-B

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4042A	C29	ADDED .001 uF	Q6 BASE
	Q2 THRU 6	WERE 48R869570, M9570	
	Q9	WAS 48R869570	
	R9	WAS 6S129981, 3.3K	1ST. AMPLIFIER
	R11	WAS 6S131858, 270K	2ND AMPLIFIER
	R25	WAS 6S131523, 27	Q5 EMITTER
	R33	WAS 6S129804, 2.2K	Q7 EMITTER
	R35	WAS 6S131276, 150K	
	R41	WAS 6S129144, 68K	ATTENUATOR
	R42	WAS 6S129242, 56K	CIRCUIT
	R45	WAS 6S129709, 470	Q10 EMITTER
	R48	WAS 6S129981, 3.3K	Q10 BASE CIRCUIT
	R54	WAS 6S131275, 220	Q11 EMITTER
	R80	WAS 6S129431, 180	Q20 EMITTER
TLN4042A-1			

PARTS LIST

TLN4042A Guard Tone Board — PL-477-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 V; unl. stated
C1	8D82905G26	.0047
C2	8D84326A29	.005 ±2%
C3	8D82905G07	0.1
C4	8D82905G11	0.22
C5	8D82905G02	.022
C6	8D82905G02	.022
C7	8D82905G02	.022
C8	8D82905G25	.0033
C9	8D82905G01	.01
C10	8D82905G11	0.22
C11	8D82905G04	.068
C12	8D82905G04	.068
C13	8D82905G04	.068
C14	8D82905G04	.068
C15	23K865136	15 ±20%; 25 V
C16	8D82905G03	.047
C17	23K865136	15 ±20%; 25 V
C18	8D82905G04	.068
C19	8D82905G04	.068
C20	8D82905G04	.068
C21	23K865137	4.7 ±20%; 25 V
C22	23K865137	4.7 ±20%; 25 V
C23	23K865136	15 ±20%; 25 V
C24	8D82905G11	0.22
C25	23K865137	15 ±20%; 25 V
C26	8D82905G07	0.1
C27	8D82905G11	0.22
C28	23D82601A25	100 +150-10%; 20 V
C29	21C82187B14	.001; 100 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 13	48C82392B03	silicon
		COIL, ASSEMBLY, inductor:
L1	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869539	N-P-N; M9539
Q2	48R869594	N-P-N; M9594
Q3	48R869539	N-P-N; M9539
Q4	48R869539	N-P-N; M9539
Q5	48R869594	N-P-N; M9594
Q6	48R869539	N-P-N; M9539
Q7	48R869571	P-N-P; M9571
Q8	48R869570	N-P-N; M9570
Q9	48R869594	N-P-N; M9594
Q10	48R869571	P-N-P; M9571
Q11	48R869571	P-N-P; M9571
Q12 thru 19	48R869570	N-P-N; M9570
Q20	48R869571	P-N-P; M9571
Q21	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1	6S129225	10K
R2	6S128687	6.8K
R3	6S128685	22K
R4	6S124B06	220K ±5%
R5	6S124A97	100K ±5%
R6	6S129805	1K ±5%
R7	6S129668	10K ±5%
R8	6S128685	22K
R9	6S129236	15K ±5%
R10	6S129981	3.3K ±5%
R11	6S128683	150K ±5%
R12	6S131857	680K ±5%
R13	6S5556	10K ±5%; 1/2 W
R14	6S129984	680 ±5%
R15	6S131857	680K ±5%
R16	6S131858	270K ±5%
R17	6S129668	10K ±5%
R18	6S129709	470 ±5%
R19	6S128599	680
R20	6S6022	330; 1/2 W
R21	6S129681	1.5K ±5%
R22	6S124A13	33 ±5%
R23	6S129299	68K ±5%
R24	6S129886	27K ±5%
R25	6S124A01	10 ±5%
R26	6S129805	1K ±5%
R28	6S129299	68K ±5%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R29	6S129886	27K ±5%
R30	6S131523	27 ±5%
R31	6S129805	1K ±5%
R32	6S129230	12K
R33	6S131275	220 ±5%
R34	6S128902	47K
R35	6S129804	2.2K ±5%
R36	6S128987	120K
R37	6S6031	100K; 1/2 W
R38	6S128685	22K
R39	6S129144	68K
R40	6S129225	10K
R41	6S128902	47K
R42	6S129145	82K
R43	6S128689	2.2K
R44	6S129804	2.2K ±5%
R45	6S129806	330 ±5%
R46	6S129230	12K
R47	6S129231	3.3K
R48	6S129708	1.2K ±5%
R49	6S129754	33
R50	6S129754	33
R51	6S129230	12K
R52	6S129231	3.3K
R53	6S129804	2.2K ±5%
R54	6S131525	270 ±5%
R55	6S128902	47K
R56	6S127804	4.7K
R57	6S128689	2.2K
R58	6S129753	100
R59	6S6229	1K; 1/2 W
R60	6S128902	47K
R61	6S128685	22K
R62	6S129144	68K
R63	6S128685	22K
R64	6S129753	100
R65	6S129231	3.3K
R66	6S129144	68K
R67	6S128902	47K
R68	6S128902	47K
R69	6S128689	2.2K
R70	6S128689	2.2K
R71	6S129225	10K
R72	6S128902	47K
R73	6S127804	1K
R74	6S129231	3.3K
R75	6S6229	1K; 1/2 W
R76	6S127802	1K
R77	6S129232	3.9K
R78	6S127802	1K
R79	6S129804	2.2K ±5%
R80	6S131524	100 ±5%
R81	6S128689	2.2K
R82	6S129225	10K
R83	6S128689	2.2K
R84	6S129805	1K ±5%
R85	6S124A09	22 ±5%
R86	6S129299	68K ±5%
R87	6S129886	27K ±5%
R88	6S129775	330
R89	6S129755	10

TLN4043A Guard Tone Panel Kit — PL-478-O

	64B84316A01	PANEL (screened)
	45B83914G01	GUIDE, card
	3S8022	SCREW, machine: #4-40 x 1/4"; 2 used
	4S7683	LOCKWASHER: #4 int.; 2 used

"Vibrasponder" Resonant Reed — PL-479-O

	TLN6709BH	2175.0 Hz

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

FERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	6S129886	27K ±5%
	6S131523	27 ±5%
	6S129805	1K ±5%
	6S129230	12K
	6S131275	220 ±5%
	6S128902	47K
	6S129804	2.2K ±5%
	6S128987	120K
	6S6031	100K; 1/2 W
	6S128685	22K
	6S129144	68K
	6S129225	10K
	6S128902	47K
	6S129145	82K
	6S128689	2.2K
	6S129804	2.2K ±5%
	6S129806	330 ±5%
	6S129230	12K
	6S129231	3.3K
	6S129708	1.2K ±5%
	6S129754	33
	6S129754	33
	6S129230	12K
	6S129231	3.3K
	6S129804	2.2K ±5%
	6S131525	270 ±5%
	6S128902	47K
	6S127804	4.7K
	6S128689	2.2K
	6S129753	100
	6S6229	1K; 1/2 W
	6S128902	47K
	6S128685	22K
	6S129144	68K
	6S128685	22K
	6S129753	100
	6S129231	3.3K
	6S129144	68K
	6S128902	47K
	6S128902	47K
	6S128689	2.2K
	6S128689	2.2K
	6S129225	10K
	6S128902	47K
	6S128689	2.2K
	6S129225	10K
	6S127804	1K
	6S129231	3.3K
	6S6229	1K; 1/2 W
	6S127802	1K
	6S129232	3.9K
	6S127802	1K
	6S129804	2.2K ±5%
	6S131524	100 ±5%
	6S128689	2.2K
	6S129225	10K
	6S128689	2.2K
	6S129805	1K ±5%
	6S124A09	22 ±5%
	6S129299	68K ±5%
	6S129886	27K ±5%
	6S129775	330
	6S129755	10

4043A Guard Tone Panel Kit — PL-478-O

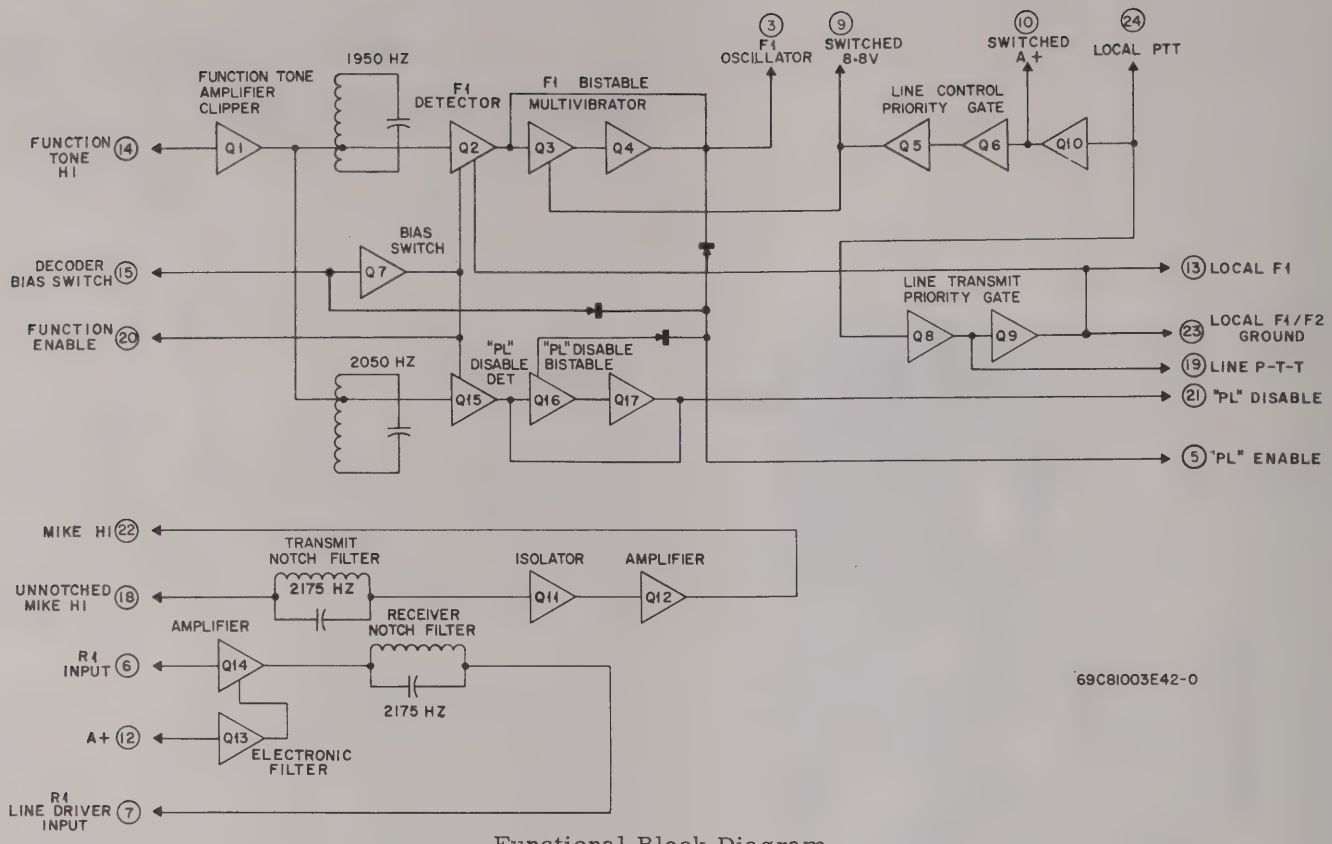
	64B84316A01	PANEL (screened)
	45B83914G01	GUIDE, card
	3S8022	SCREW, machine: #4-40 x 1/4"; 2 used
	4S7683	LOCKWASHER: #4 int.; 2 used

prasponder" Resonant Reed — PL-479-O

	TLN6709BH	2175.0 Hz

TE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

F1 frequency is keyed. This function is provided to permit the operator to monitor the channel before transmitting by disabling the "PL" function, but it automatically reverts to "PL" receive operation upon transmitting.

When a 2050 Hz tone is received, it is routed through Q1 as before, then to the "PL" disable detector, Q15 through the L4-C33 network. The detector triggers the "PL" Disable Bistable Multivibrator, Q16 and Q17, to change state and apply a ground through pin 21. This ground is routed to the appropriate point to disable the receiver "Private-Line" circuit.

Local transmission direct from the base station is controlled by applying a ground to the local P-T-T terminal, pin 24. This applies power to the F1 Bistable Multivibrator through transistors Q10, Q5, and Q6; and causes it to change state through the Line Transmit Priority Gate Q8 and Q9.

If while a local transmission is being made line push-to-talk occurs, the F1 Bistable Multivibrator is turned off by the sudden application of the line P-T-T and local transmit defeat, causing a momentary loss of switched 8.8 volts. After the line-controlled transmission is completed, the local transmission continues.

The receiver notch filter between the receiver terminal, pin 6, and the line driver input, pin 7, prevents false guard tone decoder responses from receiver noise or speech signals by removing all the 2175 Hz components. The transmit notch filter, between pins 18 and 22, prevents the 2175 Hz guard tone from modulating a line-controlled transmission. Both notch filters have a notch depth greater than 45 dB at 2175 Hz. The electronic filter, Q13, and its associated components protects the receiver notch filter from any ripple appearing on the A+ line, which might disturb this very low level stage.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the

remote control chassis. To initially determine the location of the fault, operate the station locally, and initiate the desired function from the module. If the desired function occurs, then the module is functioning properly. If the function does not occur, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and reinsert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module:

PIN NUMBER	CONNECTION
1, 2, 4, 7	Ground
3	10K ohms to pin 12
5	10K ohms to pin 12
10	to pin 12
11	1000 ohms to ground; 200 ohms to pin 12
12	A+ 13.6 volts dc
14	oscillator input
18	1000 ohms to ground; 1000 ohms to pin 12
20	to pin 1
21	100K ohms to pin 12
23	100K ohms to pin 11

c. Normal Conditions

The following chart tabulates normal levels and values for proper operation of the F1-"PL" Disable Control Module. Excessive deviation from these values indicates abnormal conditions.

Function	Typical Value
Overdrive level to F1 Detector @ 1950 Hz	9 dB
Overdrive level to "PL" Disable Detector @ 2050 Hz	9 dB
Switched 8.8 volt line	0 v dc (standby) 8 v dc (transmit)
F1 Tank Circuit Frequency	1950 Hz
"PL" Disable Tank Circuit Frequency	2050 Hz
F1 Pull-in Bandwidth (constant amplitude)	60 Hz
"PL" Disable Pull-in Bandwidth (constant amplitude)	60 Hz
Transmit Notch Frequency	2175 Hz
Receive Notch Frequency	2175 Hz
Transmit Notch Depth	Greater than 45 dB
Receive Notch Depth	Greater than 45 dB
Transmit Notch Insertion Loss @ 1 kHz (pin 18 to pin 22)	0 dB
Receive Notch Insertion Loss @ 1 kHz (pin 6 to pin 7)	2 dB

d. Stage Malfunction Location Techniques

(1) General

To locate a malfunction within the circuit module, a locally-injected signal may be applied to the input of a tone detector stage. If the tone causes the following bistable multivibrator to turn on, the preceding function tone amplifier stage should be investigated. If the bistable multivibrator does not turn on, the detector and multivibrator should be checked for proper voltages and operation.

(2) F1 Bistable Multivibrator

(a) Connect a dc voltmeter to the collector of Q4.

(b) Inject a 1950 Hz tone into tuned circuit L1 and C4 through a coupling capacitor, at a level not exceeding 1 volt.

(c) If the voltage at the collector changes to the value indicated on the schematic diagram for the operated condition, the bistable multivibrator is functioning. Check the function tone amplifier stage for a malfunction that prevents proper operation of the module.

(3) Function Tone Amplifier Stage

(a) Connect an audio oscillator to pin 14 (high) and pin 1 (ground). Set the oscillator to 1000 Hz at -10 dBm.

(b) Measure the output level at the collector of Q1. The level should be at least +10 dBm. As viewed on an oscilloscope, the waveform should be well into clipping condition.

(c) If the preceding conditions cannot be obtained, check voltages and components of the function tone amplifier stage.

(4) Transmit Notch Filter Stage

(a) Connect the biasing resistor network to pin 18 as indicated in the table.

(b) Connect an audio oscillator between pin 17 (low side) through a .1 uF capacitor to pin 18 (high side).

(c) Connect an ac voltmeter to pins 17 and 22 to measure output as audio is injected from the oscillator.

(d) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltage at each frequency.

(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the transmit notch filter stage.

(5) Receiver Notch Filter Stage

(a) Connect an audio oscillator across pin 6 (high side) and ground.

(b) Connect an ac voltmeter between pin 7 and pin 4.

(c) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltages at each frequency.

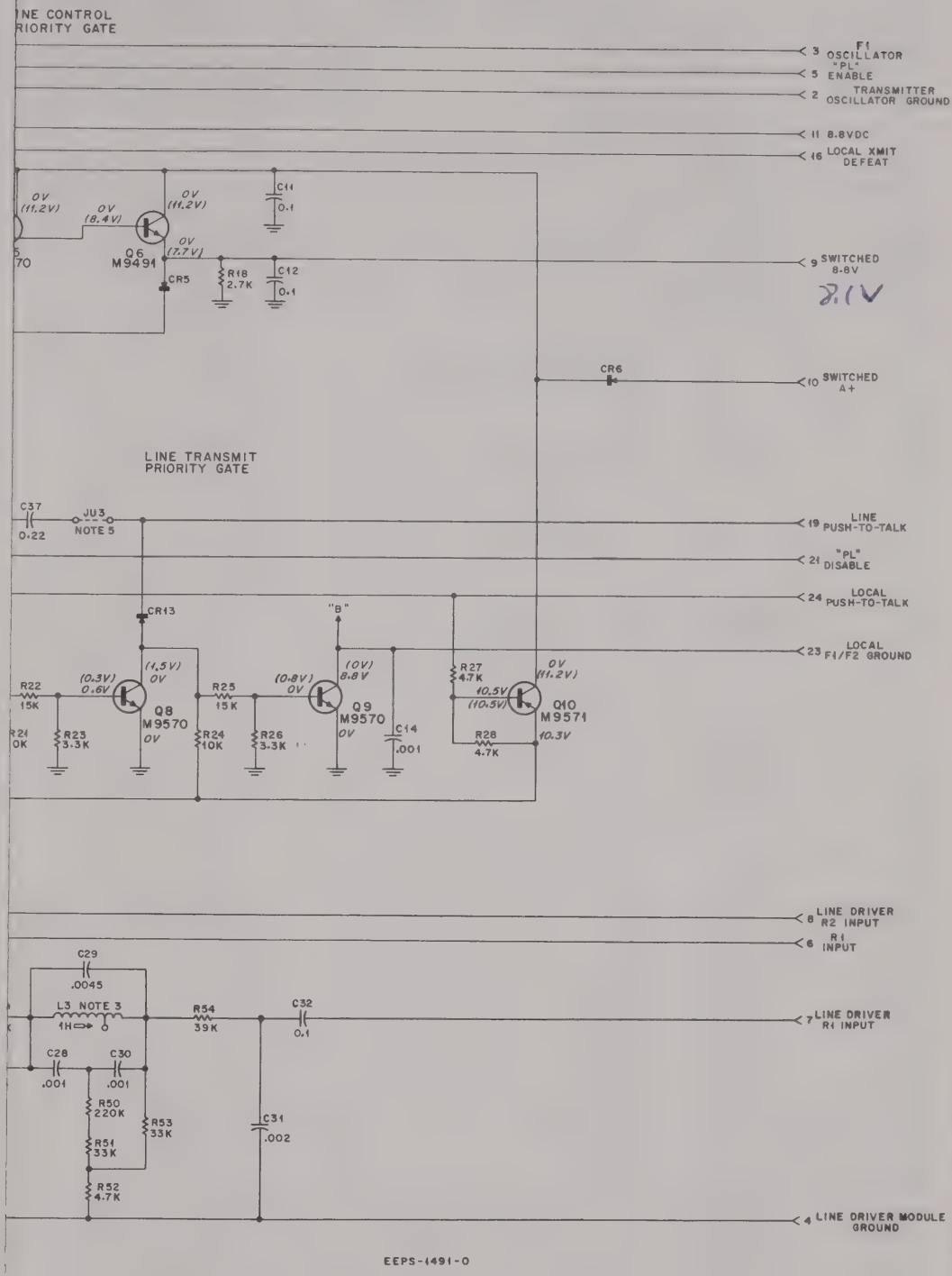
(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the receiver notch filter stage.

(6) "PL" Disable Bistable Multivibrator

(a) Connect a dc voltmeter to the collector of Q17.

(b) Inject a 2050 Hz tone into tuned circuit L4-C33 through a coupling capacitor, at a level not exceeding 1 volt.

(c) If the voltage at the collector changes to the value indicated on the schematic diagram for the operated condition, the bistable multivibrator is functioning. Check the function tone amplifier stage for a malfunction that prevents proper operation of the module.



F1 PL CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
and Circuit Board Detail
Motorola No. 63P81004E89-O
5/17/69-CP

(b) Inject a 1950 Hz tone into tuned circuit L1 and C4 through a coupling capacitor, at a level not exceeding 1 volt.

(c) If the voltage at the collector changes to the value indicated on the schematic diagram for the operated condition, the bistable multivibrator is functioning. Check the function tone amplifier stage for a malfunction that prevents proper operation of the module.

(3) Function Tone Amplifier Stage

(a) Connect an audio oscillator to pin 14 (high) and pin 1 (ground). Set the oscillator to 1000 Hz at -10 dBm.

(b) Measure the output level at the collector of Q1. The level should be at least +10 dBm. As viewed on an oscilloscope, the waveform should be well into clipping condition.

(c) If the preceding conditions cannot be obtained, check voltages and components of the function tone amplifier stage.

(4) Transmit Notch Filter Stage

(a) Connect the biasing resistor network to pin 18 as indicated in the table.

(b) Connect an audio oscillator between pin 17 (low side) through a .1 uF capacitor to pin 18 (high side).

(c) Connect an ac voltmeter to pins 17 and 22 to measure output as audio is injected from the oscillator.

(d) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltage at each frequency.

(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the transmit notch filter stage.

(5) Receiver Notch Filter Stage

(a) Connect an audio oscillator across pin 6 (high side) and ground.

(b) Connect an ac voltmeter between pin 7 and pin 4.

(c) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltages at each frequency.

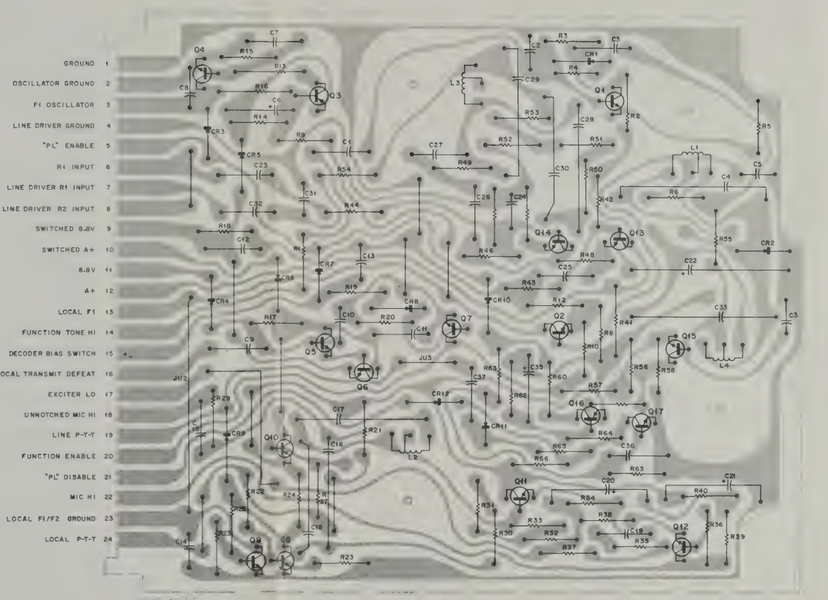
(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the receiver notch filter stage.

(6) "PL" Disable Bistable Multivibrator

(a) Connect a dc voltmeter to the collector of Q17.

(b) Inject a 2050 Hz tone into tuned circuit L4-C33 through a coupling capacitor, at a level not exceeding 1 volt.

(c) If the voltage at the collector changes to the value indicated on the schematic diagram for the operated condition, the bistable multivibrator is functioning. Check the function tone amplifier stage for a malfunction that prevents proper operation of the module.



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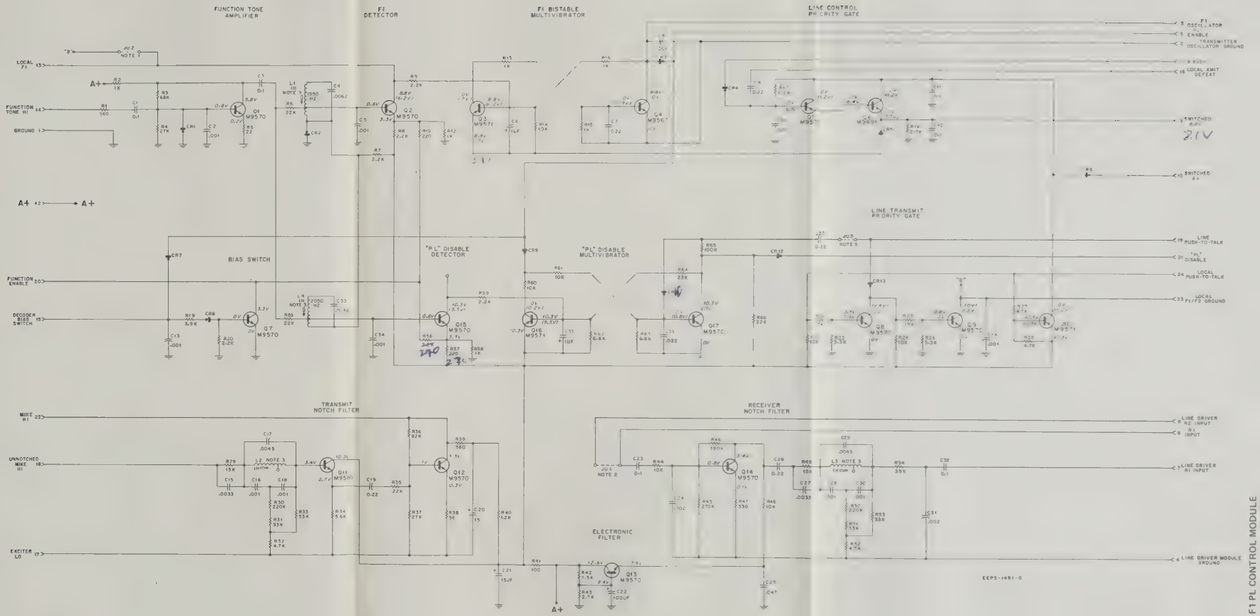


NOTES:

1. JU2 REMOVED WHEN 2-FREQUENCY TRANSMITTERS ARE USED.
2. JU1 REMOVED EXCEPT ON 2-RECEIVER STATIONS WITHOUT 4-WIRE AUDIO, OR 3-RECEIVER STATIONS WITH SEPARATE TRANSMITTER AND RECEIVER AUDIO LINES.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.
4. VOLTAGES IN PARENTHESES ARE FOR ACTIVATED CONDITION.
5. ADD JU3 FOR AUTOMATIC RECEIVER "PL" ENABLE BY LINE PUSH-TO-TALK.

EPS-2105-O

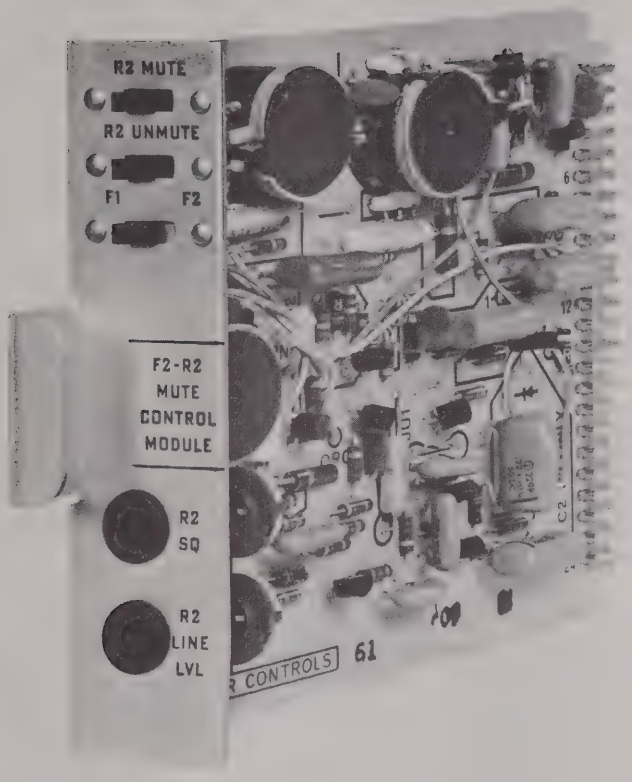
PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E89-O
5/17/69-CP

F1 PL CONTROL MODULE

F2-R2 MUTE CONTROL MODULE

MODEL TLN1247A



1. DESCRIPTION

The TLN1247A F2-R2 Mute Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module contains line level and squelch controls for a second receiver. It also contains circuitry for selection of the F2 transmit frequency and muting or unmuting of the second receiver. Frequency selection and receiver muting and unmuting are performed with tone inputs of the proper frequencies from a remote source. The F2 frequency selection is accomplished with a 1850 Hz tone; the R2 mute function requires a 1750 Hz tone; and the R2 unmute function is performed with a 1650 Hz tone.

3. CIRCUIT DESCRIPTION

When a ground is applied to the function enable line, pin 13, all detector stages, Q1, Q5, and Q8 are operational. For the F2 detector, switched 8.8 volts must also be present at pin 8. While the detectors are energized, the function tone, amplified and clipped in the Q4 stage, passes on to the appropriate detector stage.

When a 1850 Hz tone leaves tone amplifier stage Q4 and passes through tuned circuit L1-C1, it enters F2 detector stage Q1. Detection causes the F2 bistable multivibrator, Q2 and Q3, to change state and apply a ground to the F2 channel element via pin 4.

A 1750 Hz tone passing through amplifier stage Q4 is amplified and clipped to a +16 dBm level. This tone will pass through the L2-C10 tuned circuit and be detected in R2 mute detector

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 W. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4040A "F1-PL" Control Board PL-442-O

		CAPACITOR, fixed: uF; ±10%; 50 v; unl. stated
C1, 3, 11, 12, 23, 32	8D82905G07	0.1
C2, 5, 8, 10, 13, 14, 34	21D82187B29	.001; 100 v
C4	8D84326A14	.0062 ±2%
C6, 35	23D82783B08	1 ±20%; 35 v
C7, 36	8D82905G02	.022
C9, 19, 26, 37	8D82905G11	0.22
C15, 27	8D82905G25	.0033
C16, 18, 28, 30	8C82284C01	.001
C17, 29	8C84326A30	.0045 ±1%
C20, 21	23K865136	15 ±20%; 25 v
C22	23D82601A25	100 +150-10%; 20 v
C24, 31	21D82187B27	.002; 100 v
C25	8D82905G03	.047
C33	8D84326A13	.0056 ±2%
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 12	48C82392B03	silicon
		REACTOR:
L1, 2, 3, 4	1V80702B11	(factory-adjusted); res 40 ohms ±10%; includes grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 5, 7, 8, 9, 11, 12, 13, 14	48R869570	N-P-N; type M9570
Q3, 10	48R869571	P-N-P; type M9571
Q4	48R869567	N-P-N; type M9567
Q6	48R869491	N-P-N; type M9491
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129620	560
R2, 12, 58	6S129805	1K ±5%
R3	6S129299	68K ±5%
R4, 55	6S129886	27K ±5%
R5	6S124A09	22 ±5%
R6	6S129667	22K ±5%
R7, 20	6S128689	2.2K
R8, 9, 56, 59	6S129804	2.2K ±5%
R10, 57	6S131275	220 ±5%
R13, 16	6S6229	1K; 1/2 w
R14, 21, 24, 44, 60, 61	6S129225	10K
R15	6S127802	1K
R17, 65	6S129226	100K
R18, 43	6S128688	2.7K
R19	6S129232	3.9K
R22, 25, 29, 49	6S127805	15K
R23, 26	6S129231	3.3K
R27, 28	6S127804	4.7K
R30, 50	6S131858	220K ±5%
R31, 33, 51, 53	6S129526	33K ±5%
R32, 52	6S129669	4.7K ±5%
R34	6S129433	5.6K
R35	6S128685	22K
R36	6S129145	82K
R37	6S127806	27K
R38	6S124A19	56 ±5%
R39	6S129779	560 ±5%
R40	6S129235	1.2K
R41	6S6326	100; 1/2 w
R42	6S127803	1.5K
R45	6S131858	270K ±5%
R46	6S124D12	390K ±5%
R47	6S129806	330 ±5%
R48	6S129668	10K ±5%
R54	6S128903	39K
R62, 63	6S128687	6.8K

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN4041A "F1-PL" Control Panel PL-441-O

NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4040A "F1-PL" Control Board PL-442-O

		CAPACITOR, fixed: uF; ±10%; 50 v; unl. stated
C1, 3, 11, 12, 23, 32	8D82905G07	0.1
C2, 5, 8, 10, 13, 14, 34	21D82187B29	.001; 100 v
C4	8D84326A14	.0062 ±2%
C6, 35	23D82783B08	1 ±20%; 35 v
C7, 36	8D82905G02	.022
C9, 19, 26, 37	8D82905G11	0.22
C15, 27	8D82905G25	.0033
C16, 18, 28, 30	8C82284C01	.001
C17, 29	8C84326A30	.0045 ±1%
C20, 21	23K865136	15 ±20%; 25 v
C22	23D82601A25	100 +150-10%; 20 v
C24, 31	21D82187B27	.002; 100 v
C25	8D82905G03	.047
C33	8D84326A13	.0056 ±2%
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 12	48C82392B03	silicon
		REACTOR:
L1, 2, 3, 4	1V80702B11	(factory-adjusted); res 40 ohms ±10%; includes grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 5, 7, 8, 9, 11, 12, 13, 14	48R869570	N-P-N; type M9570
Q3, 10	48R869571	P-N-P; type M9571
Q4	48R869567	N-P-N; type M9567
Q6	48R869491	N-P-N; type M9491
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129620	560
R2, 12, 58	6S129805	1K ±5%
R3	6S129299	68K ±5%
R4, 55	6S129886	27K ±5%
R5	6S124A09	22 ±5%
R6	6S129667	22K ±5%
R7, 20	6S128689	2.2K
R8, 9, 56, 59	6S129804	2.2K ±5%
R10, 57	6S131275	220 ±5%
R13, 16	6S6229	1K; 1/2 w
R14, 21, 24, 44, 60, 61	6S129225	10K
R15	6S127802	1K
R17, 65	6S129226	100K
R18, 43	6S128688	2.7K
R19	6S129232	3.9K
R22, 25, 29, 49	6S127805	15K
R23, 26	6S129231	3.3K
R27, 28	6S127804	4.7K
R30, 50	6S131858	220K ±5%
R31, 33, 51, 53	6S129526	33K ±5%
R32, 52	6S129669	4.7K ±5%
R34	6S129433	5.6K
R35	6S128685	22K
R36	6S129145	82K
R37	6S127806	27K
R38	6S124A19	56 ±5%
R39	6S129779	560 ±5%
R40	6S129235	1.2K
R41	6S6326	100; 1/2 w
R42	6S127803	1.5K
R45	6S131858	270K ±5%
R46	6S124D12	390K ±5%
R47	6S129806	330 ±5%
R48	6S129668	10K ±5%
R54	6S128903	39K
R62, 63	6S128687	6.8K

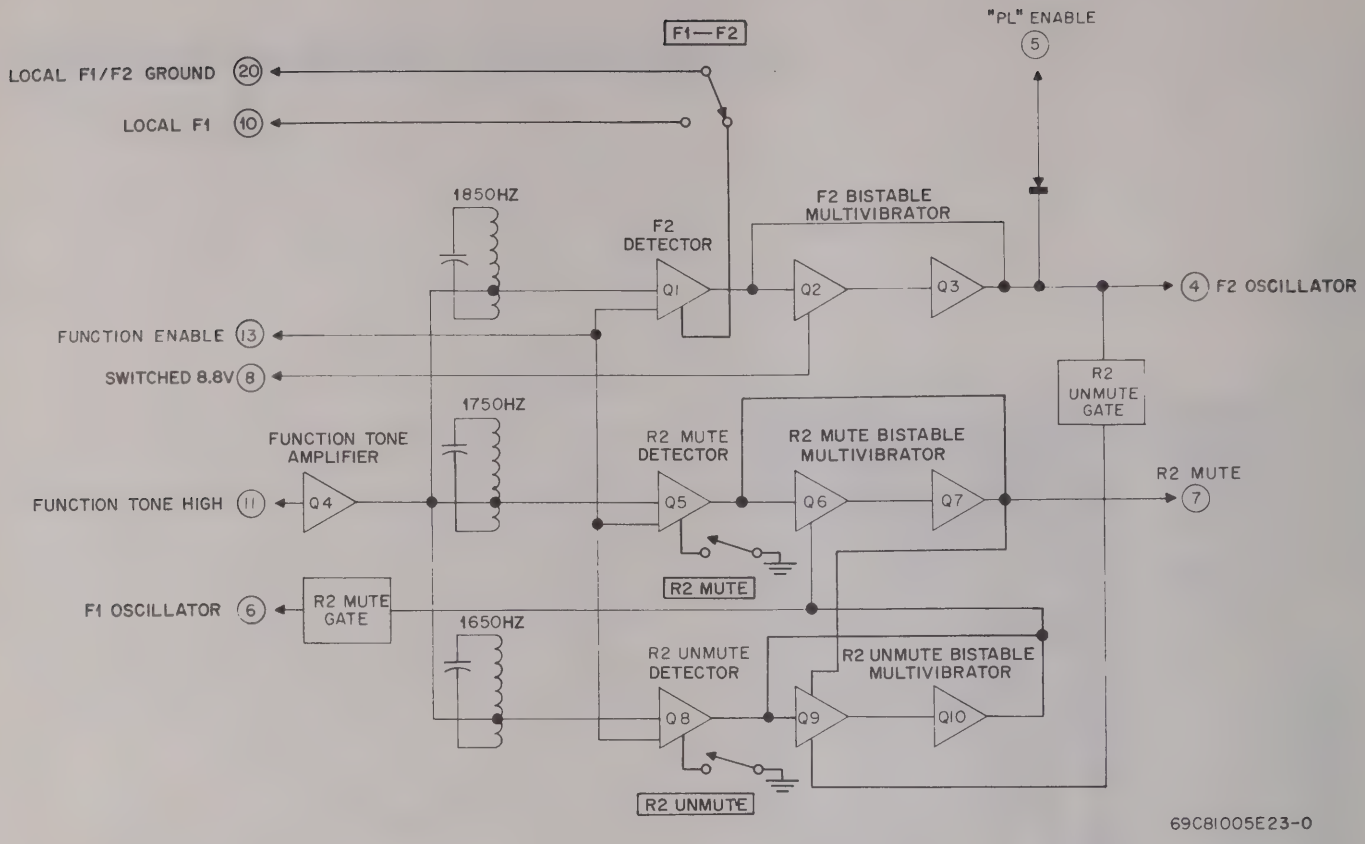
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN4041A "F1-PL" Control Panel PL-441-O

NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

stage Q5, causing the R2 mute bistable multivibrator, A6 and Q7, to change state. This change of state causes a ground to be applied through resistor R31 and diode CR10 to pin 7 for muting receiver R2. Concurrently, the ground also blocks drive to transistor Q10 in the R2 Unmute bistable multivibrator through diode CR9, turning off the unmute bistable multivibrator.

A 1650 Hz tone passing through the amplifier stage Q4 is amplified and clipped as previously described. This tone passes through the L3-C16 tuned circuit into R2 unmute detector stage Q8. Detection here causes the R2 unmute bistable multivibrator Q9 and Q10 to trigger to its on state, blocking the drive to transistor Q7 in the R2 mute bistable multivibrator. In this condition, the mute bistable cuts off, removing the ground from the receiver, which unmutes it.

Controls for the station second receiver are included on the circuit board. Potentiometer R19 adjusts the line level output from the receiver, and potentiometer R17 sets the squelch threshold level for the second receiver.

The second receiver may also be muted or unmuted by operating the appropriate switch on the front panel. The panel switches directly operate the proper bistable multivibrator.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To initially determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired operation occurs, the module is functioning properly. If it does not occur the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station.

To gain access to the module, remove it, insert a Model TLN8799A PC Service Board, and re-insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done after proper power and terminations are connected to the module:

PIN NUMBER	CONNECTION
1, 2, 13	Ground
4	10K ohms to pin 12
5	10K ohms to pin 12
7	100K ohms to pin 12
8	to pin 12
11	oscillator input
12	A+ 13.6 volts dc

c. Normal Conditions

The following chart tabulates normal levels and values for proper operation of the F2-R2 Mute Control Module. Excessive deviations from these values indicates abnormal conditions in the module.

Function	Typical Value
F2 Tank Circuit Frequency	1850 Hz
R2 Mute Tank Circuit Frequency	1750 Hz
R2 Unmute Tank Circuit Frequency	1650 Hz
F2 Pull-in Bandwidth (constant amplitude)	60 Hz
R2 Mute Pull-in Bandwidth (constant amplitude)	60 Hz
R2 Unmute Pull-in Bandwidth (constant amplitude)	60 Hz
F2 Detector Overdrive @ 1850 Hz	9 db
R2 Mute Detector Overdrive @ 1750 Hz	9 db
R2 Unmute Detector Overdrive @ 1650 Hz	9 db

d. Module Malfunction Location Techniques

(1) F2 Control Stages

(a) Connect a dc voltmeter across pin 4 and pin 2.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1850 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check detector stage Q1, then bistable multivibrator Q2 and Q3. If the change of state occurs, check the function tone amplifier for a malfunction.

(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q4 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1800 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

(d) If the previous conditions are not attained, measure the voltages on the function tone detector stage.

(3) R2 Mute Stages

(a) Connect a dc voltmeter across the collector of transistor Q7 and ground (pin 1).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q5. The output level must not exceed 1 volt.

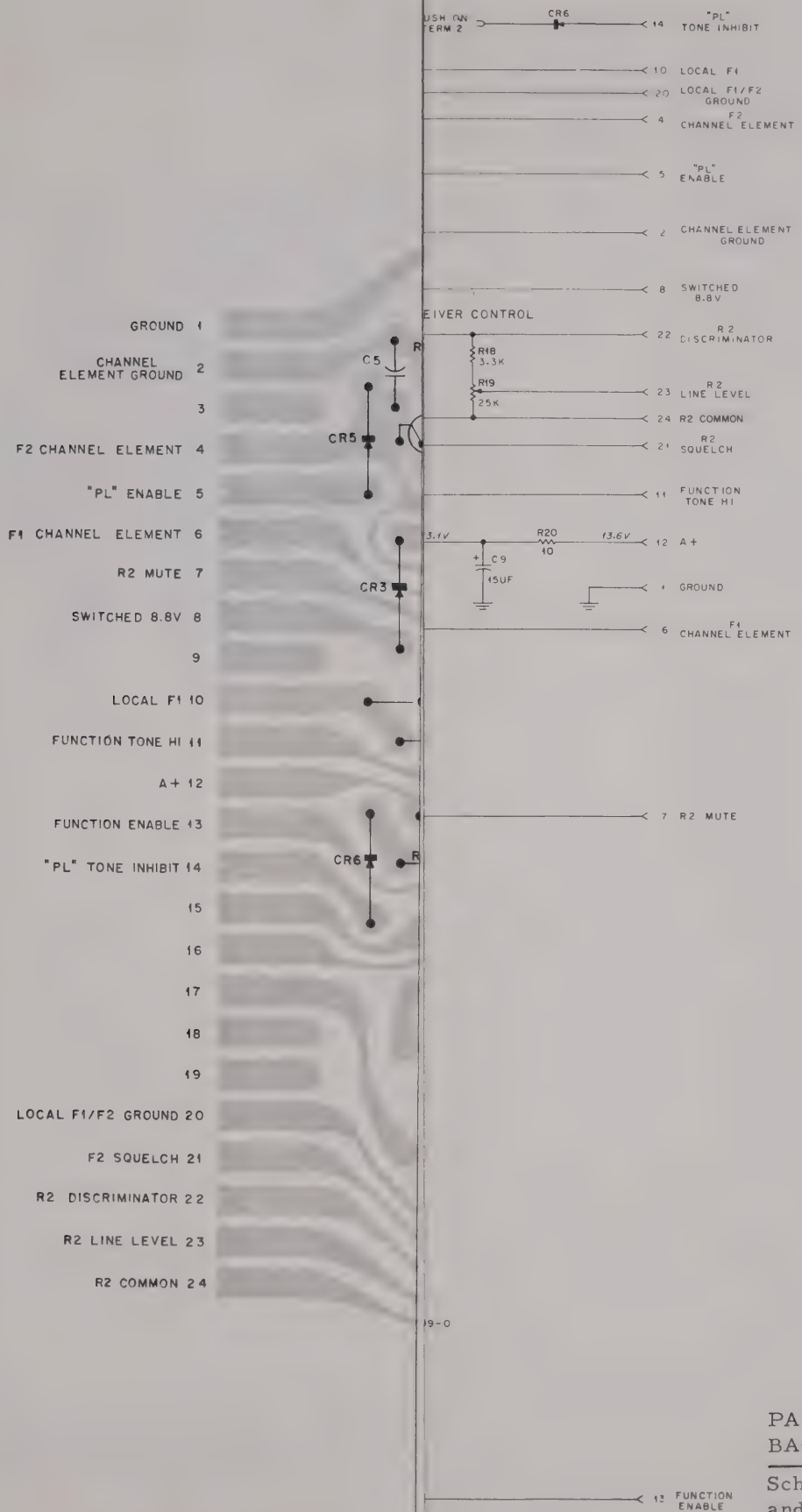
(c) Adjust the oscillator frequency to 1750 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check detector stage Q5, then bistable multivibrator Q6 and Q7. If the change of state occurs, look to the function tone amplifier for a malfunction.

(4) R2 Unmute Stages

(a) Connect a dc voltmeter across the collector of transistor Q10 and ground (pin 1).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q8. The output level from the oscillator must not exceed 1 volt.

(c) Adjust the oscillator frequency to 1650 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the multivibrator does not change state, check detector stage Q8, then bistable multivibrator Q9 and Q10. If the change of state occurs, check the R2 Mute stages as previously described.

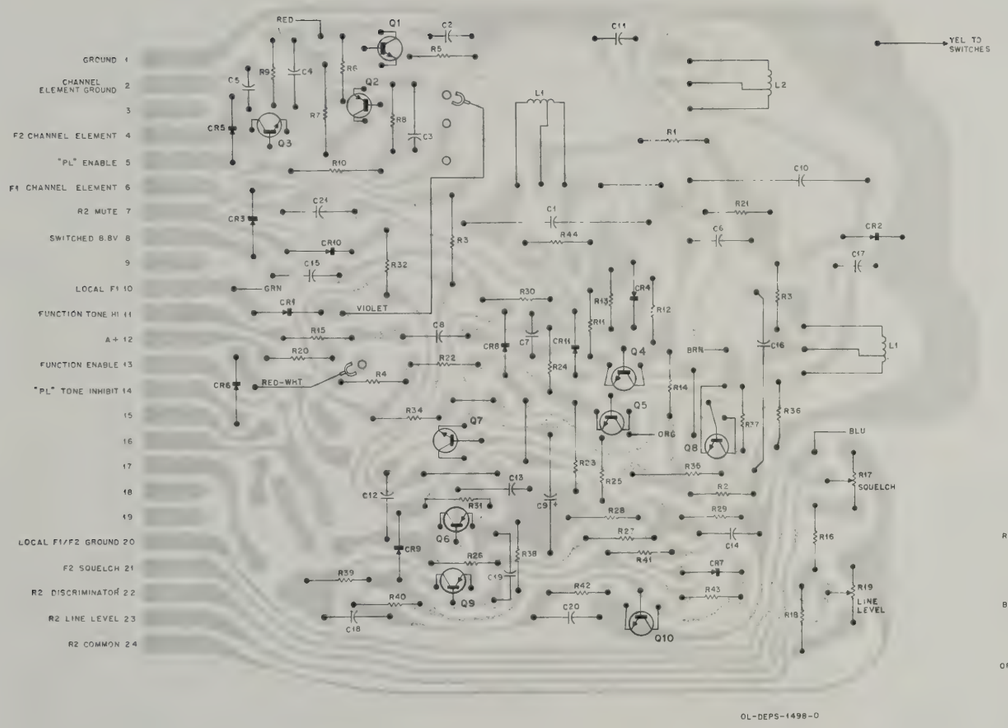


F2-R2 MUTE CONTROL MODULE

SQUELCH CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
and Circuit Board Detail
Motorola No. 63P81004E97-O
5/17/69-CP



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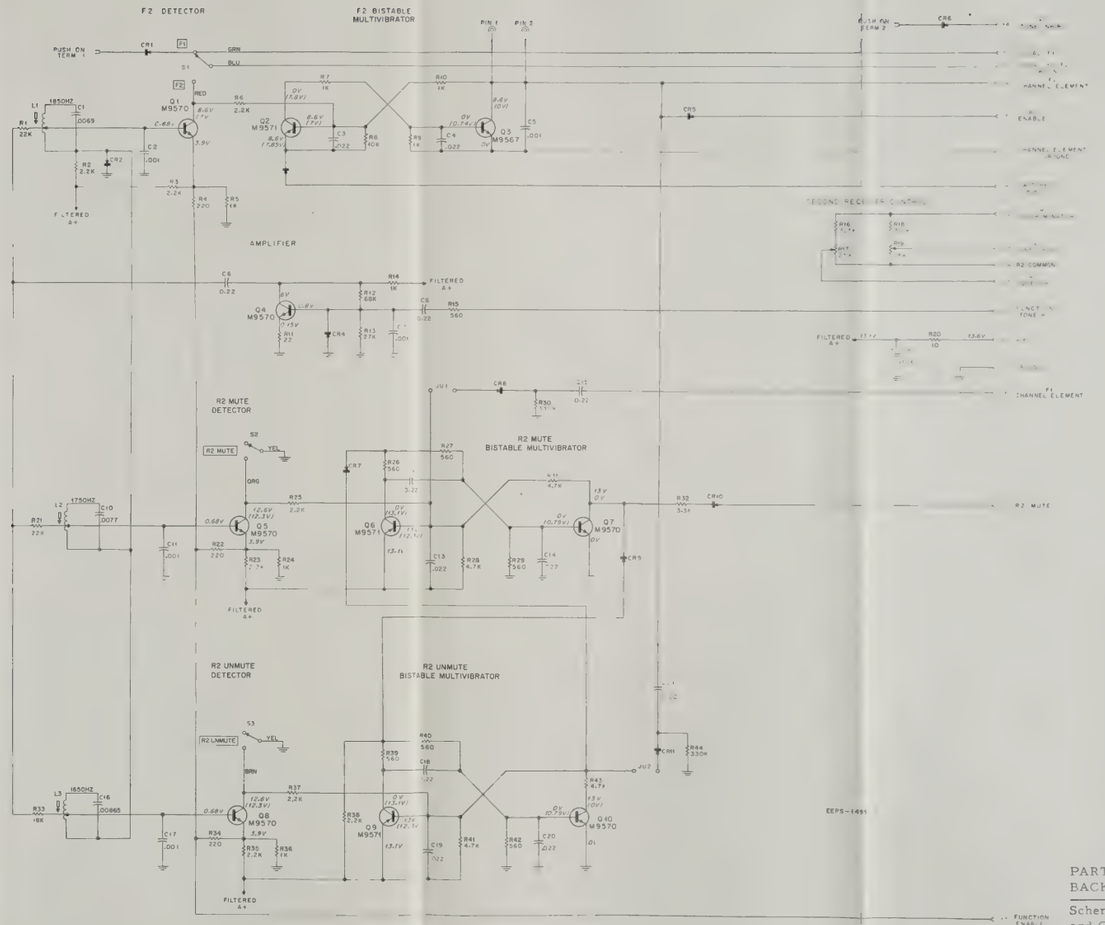


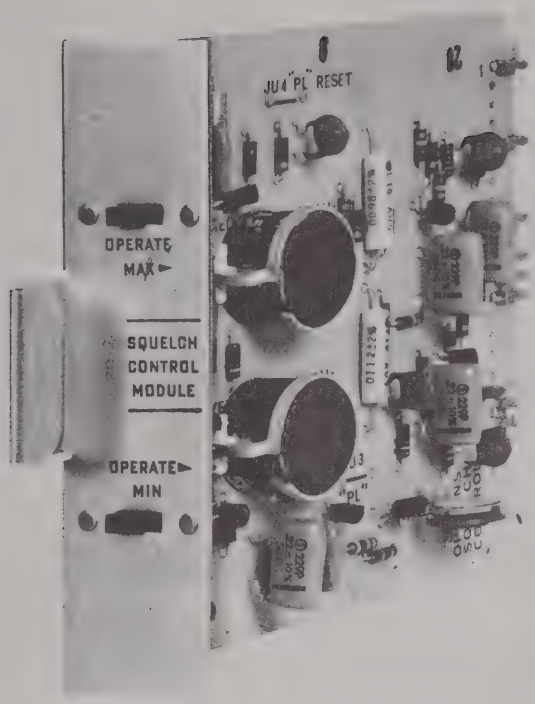
F2 R2 MUTE CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E97-O
5/17/69-CP

SQUELCH CONTROL MODULE

MODEL TLN1249A



1. DESCRIPTION

The TLN1249A Squelch Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module provides selection of squelch level on tone command from a remote control point. When the proper frequency tone command is detected in the module, the squelch level for the station receiver is set to threshold or to maximum, as determined by the input tone frequency. A 1450 Hz tone sets up threshold squelch while a 1550 Hz tone sets up maximum squelch.

3. CIRCUIT DESCRIPTION

A 1550 Hz tone applied to pin 11 is amplified and clipped in the Q1 amplifier stage. This tone will pass through the tuned circuit (L1-C4) and be detected in the Q2 tone detector stage. Detection of the tone causes the bistable multivibrator stage (Q3-Q4) to change state. This change of state causes the Operate Threshold Squelch Bistable Multivibrator (Q6-Q7) to shut off, and the attenuator transistor (Q8) to cut off. With cutoff, the transistor appears as an open circuit to the squelch control (R31). Noise entering pin 19 is attenuated through the 15K and 3.3K ohm resistors (R32 and R33), then amplified through transistor stage Q9. After amplification, the no-signal noise passes out pin 18 to the receiver noise squelch circuitry to activate a maximum squelch condition.

When a 1450 Hz tone is applied to pin 11, it is amplified and clipped in the Q1 amplifier stage as before. The tone will pass through the tuned circuit (L2-C10) and be detected in the Threshold Squelch Detector Stage (Q5). When the tone is detected, the threshold squelch bistable multivibrator (Q6-Q7) is turned on and turns off the maximum squelch bistable multivibrator stage (Q3-Q4) through diode CR6. When the threshold squelch bistable multivibrator is turned on, the base of the attenuator transistor (Q8) goes more positive, turning it on, which grounds the squelch

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PARTS LIST

TLN4046A F2-R2 Mute Decoder Board PL-485-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v; unl stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82905G11	0.22
C9	23K865136	15 ±20%; 25 v
C10	8D84326A16	.0077 ±2%
C11	21D82187B29	.001; 100 v
C12	8D82905G11	0.22
C13	8D82905G02	.022
C14	8D82905G02	.022
C15	8D82905G11	0.22
C16	8D84326A17	.00865 ±2%
C17	21D82187B29	.001; 100 v
C18	8D82905G11	0.22
C19	8D82905G02	.022
C20	8D82905G02	.022
C21	8D82905G11	0.22
		SEMICONDUCTOR DEVICE, diode, (SEE NOTE)
CR1 thru 11	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1 thru 3	1V80702B11	1H; incl ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N, M9570
Q2	48R869571	P-N-P, M9571
Q3	48R869567	N-P-N, M9567
Q4	48R869570	N-P-N, M9570
Q5	48R869570	N-P-N, M9570
Q6	48R869571	P-N-P, M9571
Q7	48R869570	N-P-N, M9570
Q8	48R869570	N-P-N, M9570
Q9	48R869571	P-N-P, M9571
Q10	48R869570	N-P-N, M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S128[illegible]	68K ±5%
R13	6S129[illegible]	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	var; 25K
R18	6S129231	3.3K
R19	18C83083G03	var; 25K
R20	6S129755	10
R21	6S129667	22K ±5%
R22	6S131275	220 ±5%
R23	6S2028	2.2K ±5%; 1/2 w
R24	6S129805	1K ±5%
R25	6S128689	2.2K
R26	6S129620	560
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129620	560
R30	6S129228	330K
R31	6S127804	4.7K
R32	6S129231	3.3K
R33	6S131520	18K ±5%
R34	6S131275	220 ±5%
R35	6S2028	2.2K ±5%; 1/2 w
R36	6S129805	1K ±5%
R37	6S128689	2.2K
R38	6S128689	2.2K
R39	6S129620	560
R40	6S129620	560
R41	6S127804	4.7K
R42	6S129620	560
R43	6S127804	4.7K
R44	6S129228	330K
		NON-REFERENCED ITEM
	42S10217A01	STRAP, cable harness

TLN4047A F2-R2 Mute Panel Kit PL-486-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SWITCH, slide:
S1	40B83204B01	dpdt
S2	40B83468E01	spdt
S3	40B83468E01	spdt
		NON-REFERENCED ITEMS
	1V80703B19	PANEL ASSY (riveted); incl. ref. parts S1, S2, and S3
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

TLN4046A F2-R2 Mute Decoder Board PL-485-O

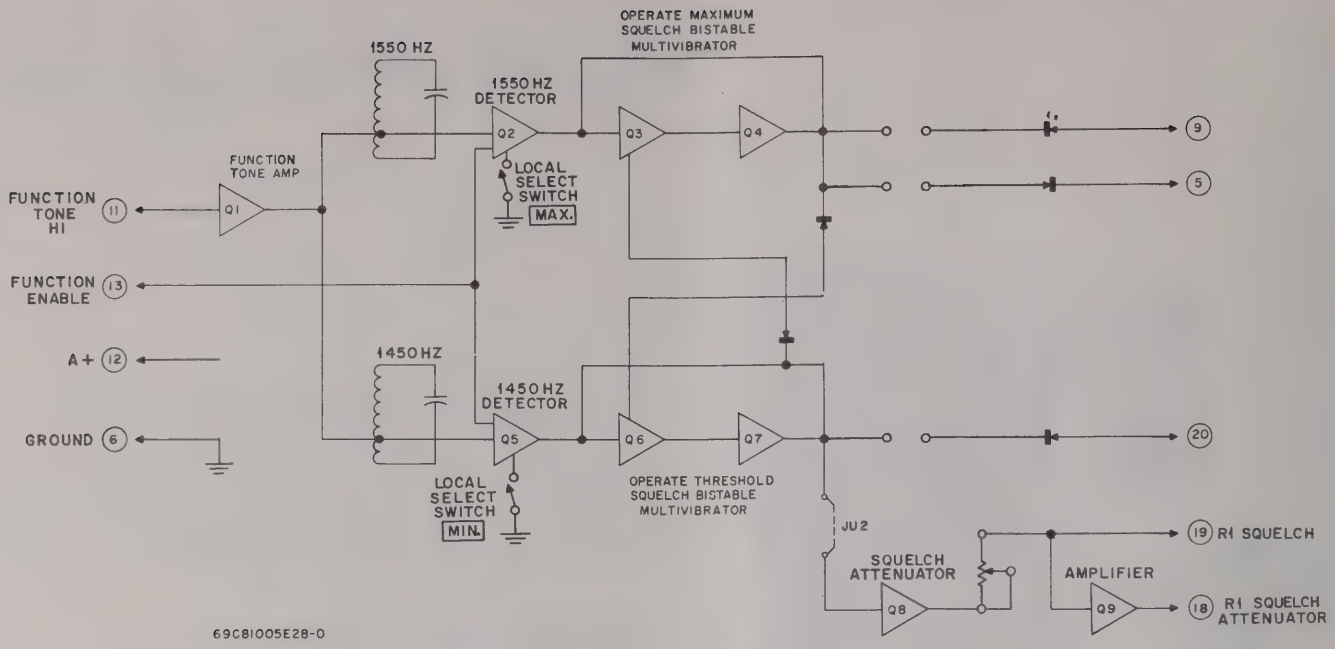
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v: unl stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82905G11	0.22
C9	23K865136	15 ±20%; 25 v
C10	8D84326A16	.0077 ±2%
C11	21D82187B29	.001; 100 v
C12	8D82905G11	0.22
C13	8D82905G02	.022
C14	8D82905G02	.022
C15	8D82905G11	0.22
C16	8D84326A17	.00865 ±2%
C17	21D82187B29	.001; 100 v
C18	8D82905G11	0.22
C19	8D82905G02	.022
C20	8D82905G02	.022
C21	8D82905G11	0.22
		SEMICONDUCTOR DEVICE, diode. (SEE NOTE)
CR1 thru 11	48C82392B03	silicon
		COIL ASSEMBLY, inductor: 1H; incl ground clip
L1 thru 3	1V80702B11	
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P. M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
Q5	48R869570	N-P-N. M9570
Q6	48R869571	P-N-P; M9571
Q7	48R869570	N-P-N. M9570
Q8	48R869570	N-P-N. M9570
Q9	48R869571	P-N-P M9571
Q10	48R869570	N-P-N M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	var; 25K
R18	6S129231	3.3K
R19	18C83083G03	var; 25K
R20	6S129755	10
R21	6S129667	22K ±5%
R22	6S131275	220 ±5%
R23	6S2028	2.2K ±5%; 1/2 w
R24	6S129805	1K ±5%
R25	6S128689	2.2K
R26	6S129620	560
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129620	560
R30	6S129228	330K
R31	6S127804	4.7K
R32	6S129231	3.3K
R33	6S131526	18K ±5%
R34	6S131275	220 ±5%
R35	6S2028	2.2K ±5%; 1/2 w
R36	6S129805	1K ±5%
R37	6S128689	2.2K
R38	6S128689	2.2K
R39	6S129620	560
R40	6S129620	560
R41	6S127804	4.7K
R42	6S129620	560
R43	6S127804	4.7K
R44	6S129228	330K
		NON-REFERENCED ITEM
	42S10217A01	STRAP, cable harness

TLN4047A F2-R2 Mute Panel Kit PL-486-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SWITCH, slide:
S1	40B83204B01	dpdt
S2	40B83468E01	spdt
S3	40B83468E01	spdt
		NON-REFERENCED ITEMS
	1V80703B19	PANEL ASSY (riveted): incl. ref. parts S1, S2, and S3
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

control potentiometer R31, allowing control of the noise level passing into the amplifier stage (Q9), where it is amplified before passing out of the circuit board on pin 18 to determine the threshold squelch level.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 13	Ground
11	Oscillator Input
12	A+ 13.6 volts dc
19	Oscillator input

c. Module Malfunction Location Techniques

(1) Operate Maximum Squelch Stages

(a) Connect a dc voltmeter from the collector of Q4 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q2. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1550 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage (Q2), then the multivibrator stage (Q3-Q4). If the change of

state occurs, look to the function tone amplifier for a malfunction.

(2) Operate Threshold Squelch Stages

(a) Connect a dc voltmeter from the collector of Q7 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q5. The output level from the oscillator must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1450 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage (Q5), then the multivibrator stage (Q6-Q7). If the change of state occurs, look to the function tone amplifier for a malfunction.

(3) Squelch Attenuator Stages

(a) Set the module for maximum squelch condition as indicated under (1) Operate Maximum Squelch Stages.

(b) Connect an ac voltmeter between pin 18 and ground.

(c) Inject a 1000 Hz tone through a .1 uF capacitor into pin 19 at a 1 volt level. The measured level at pin 18 should be 1 volt.

(d) Revert the module to the threshold squelch condition as indicated under (2) Operate Threshold Squelch Stages.

(e) Inject the 1000 Hz tone as before. Vary the setting of the squelch potentiometer on the module from minimum to maximum. The measured output level should vary from equal to the input level to approximately zero.

d. Level Settings at Time of Installation In Station

(1) Install a Model TLN8799A PC Service Board in the normal module location.

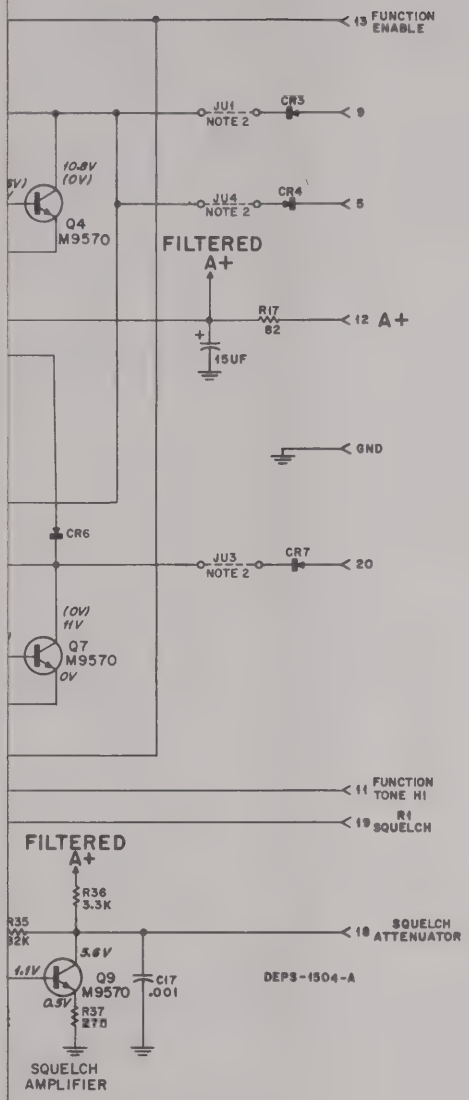
(2) Insert the module into the service board.

(3) Operate the MAX switch on the module front panel.

(4) On the Station Logic module, turn the R1 Squelch control to maximum squelch (fully clockwise).

(5) Operate the MIN switch on the squelch Control module front panel. Adjust the SQUELCH Control located on the squelch control module to threshold, then rotate 10 degrees beyond that point for its final setting.

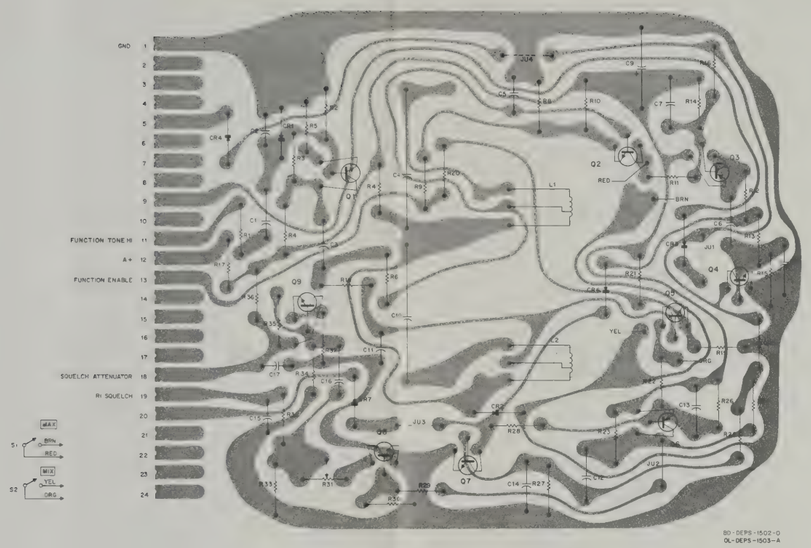
(6) Turn off power, and remove the module from the service card. Remove the service card and reinstall the module.



SQUELCH CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E28-A
1/2/70-UP



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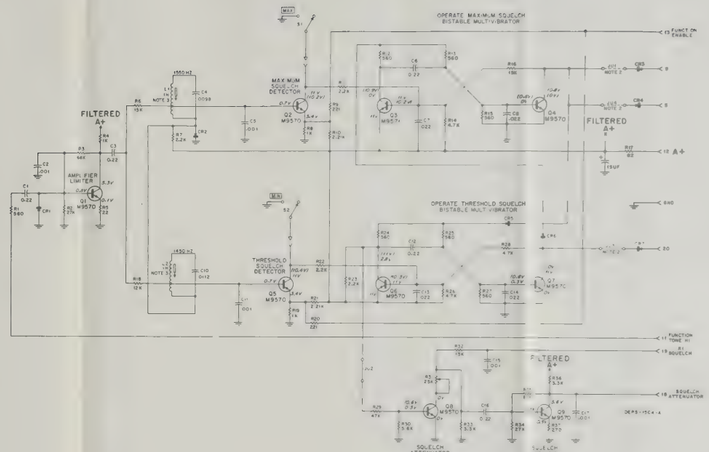
OL-DEPS-1503-A



NOTES

1. VOLTAGES IN PARENTHESES ARE FOR ACTIVATED STATE.
2. NOT USED IN THIS CIRCUIT.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.

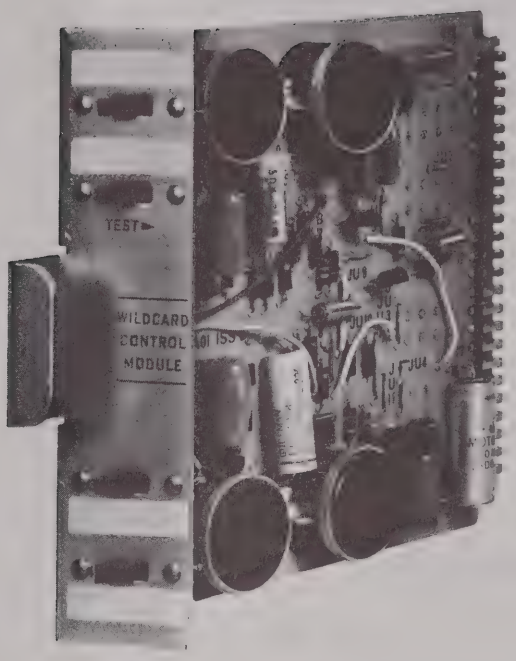
EPS-2086-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E28-A
1/2/70-UP

"WILD CARD" CONTROL MODULE

MODEL TLN1252A



1. DESCRIPTION

The TLN1252A "Wild Card" Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting pins to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

a. General

This module provides four tone-activated control circuits to operate distantly located functions. Each individual circuit, when operated, provides a ground for a 100-milliampere circuit to operate a function, or it may operate the relay in the Model TLN4151A Relay Kit, available separately for installation on the module. This relay kit provides switched contacts for higher currents and complete isolation of the switched circuit from the module. Refer to the following detail for dc contact ratings; the relay will control a 115 volts ac resistive load at 1 ampere.

3. APPLICATIONS

In general, the "Wild Card" control module may be used to provide on-off control for a multitude of functions. These typical applications could include a manual override for tower light control,

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REVISIONS

63P81005E28-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4050A	R6	WAS 6S131526, 18K	L1 TAP
	R9	WERE 6S131275, 220	Q2 EMITTER
	R20		Q5 EMITTER
	R10	WERE 6S129804, 2.2K	Q2 EMITTER
	R21		Q5 EMITTER
	R18	WAS 6S129236, 15K	L2 TAP
TLN4050A-1			

PARTS LIST

TLN4050A Control Board — PL-431-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 3, 6, 12, 16	8D82905G11	0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF +10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon
		REACTOR:
L1, 2	1V80702B11	AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 4, 5, 7, 8, 9	48R869570	N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1, 12, 13, 15, 24, 25, 27	6S129620	560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S129236	15K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6D84444A07	221 ±1%
R10, 21	6D84444A08	2,21K ±1%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129887	12K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4051A Squelch Control Panel — PL-432-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd.

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

REVISIONS

63P81005E28-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4050A	R6	WAS 6S131526, 18K	L1 TAP
	R9	WERE 6S131275, 220	Q2 EMITTER
	R20		Q5 EMITTER
	R10	WERE 6S129804, 2.2K	Q2 EMITTER
	R21		Q5 EMITTER
	R18	WAS 6S129236, 15K	L2 TAP
TLN4050A-1			

PARTS LIST

TLN4050A Control Board — PL-431-A

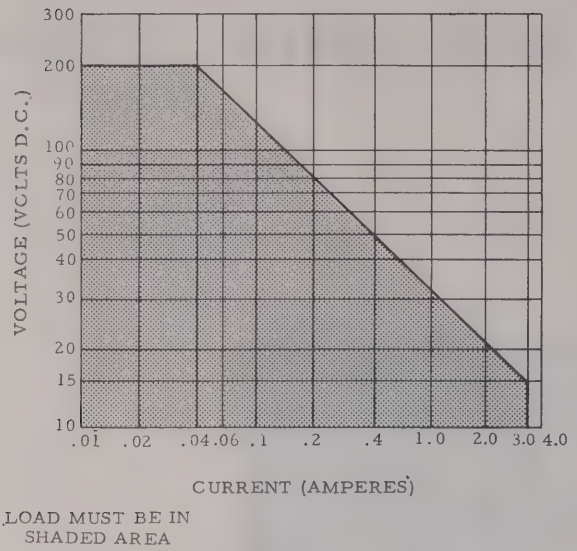
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 3, 6, 12, 16	8D82905G11	0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF +10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon
		REACTOR:
L1, 2	1V80702B11	AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 4, 5, 7, 8, 9	48R869570	N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1, 12, 13, 15, 24, 25, 27	6S129620	560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S129236	15K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6D84444A07	221 ±1%
R10, 21	6D84444A08	2.21K ±1%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129887	12K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4051A Squelch Control Panel — PL-432-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd.

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



AEPS-1527-O

Relay Contact DC Current Ratings

switching of battery charging and equalizing equipment, antenna selection, operation of sirens or public address equipment, remote transfer of lines, or test running of emergency power sources.

4. CIRCUIT CONNECTIONS

a. Operation Without TLN4151A Relay Kit

When the module is used to operate external functions directly without relays, jumpers JU1 through JU4 should be in place. When the appropriate Function Bistable Multivibrator is operated, a ground appears at the respective terminal contact as follows:

Operating Tone-Hz	Bistable Operated	Ground Appears At Contact No.
1350	No. 1	3
1250	No. 2	8
1150	No. 3	16
1050	No. 4	23

b. Operation With TLN4151A Relay Kit

When a Model TLN4151A Relay Kit is installed to provide additional switched circuit current-handling capability for a function bistable multivibrator on the module, jumpers must be removed for proper operation of the relay contact circuitry. Refer to the following table.

When Relay is Installed For Bistable No.:	Remove Jumper No.:
1	JU1
2	JU2
3	JU3
4	JU4

NOTE

For control of external devices using the multivibrator outputs with or without the relay kits, external connections must be made directly to the appropriate pins on the interconnect board. Refer to the schematic diagram for connection information.

c. Paired Reset Function Bistable Multivibrator Operation

For certain applications, it may be desirable to operate two of the function bistable multivibrators as a pair. In this condition, the actuation of one of the pair causes its mate to go to its unactuated state. The paired functioning is controlled by specific jumpers. Refer to the following table:

To Operate Bistable Multivibrators As Pairs	Connect Jumpers
Functions No. 1 & 2	JU5, JU6
Functions No. 3 & 4	JU7, JU8

The bistable multivibrator circuitry is established to provide an "on" function in the Function No. 1 and Function No. 3 bistable multivibrators whenever the power is applied, and also return to this condition after restoration of power following an interruption.

d. Four-Bistable Memory or Independent Bistable Operation

When jumpers JU5, JU6, JU7, JU8, and JU9 are removed, each bistable multivibrator can be operated independently, and reset only as a group by the interruption of A+ power on pin 19. The tone detector is unaffected by the reset interruption, as it is supplied with A+ from the normal pin 12.

5. THEORY OF OPERATION

a. Introduction

The TLN1252A "Wild Card" Module comprises four detector and bistable multivibrator circuits

driven by a common tone amplifier-clipper stage. The tone detector and amplifier stages are identical except for the acceptance frequency of each tuned circuit in the tone detector stage. The following circuit description applies for each individual Function Stage, considering the appropriate tone frequency used, when necessary.

b. Circuit Operation

When a function tone enters the module on pin 11, it is amplified and clipped to a +16 dBm level in transistor stage Q1. A 1350 Hz tone will pass through the tuned circuit (L1-C4) into the tone detector stage (Q2). When it is detected, it causes the Function No. 1 Bistable Multivibrator (Q3-Q4) to change state, causing the collector of Q4 to go to ground. If a relay is not used with the Function No. 1 stage, this ground is applied through the jumper (JU1) to pin 3 of the module to operate the external circuit. The circuit remains in this actuated condition until the A+ voltage to the bistable multivibrator, fed through pin 19, is momentarily interrupted to reset all stages.

When a TLN4151A Relay Kit is installed in the stage, operation is as previously described, except that the ground at the collector of Q4 is applied to the relay coil, which operates the relay. The external circuit is controlled by the relay contacts connected to module pins 3, 4, and 5 with the jumper (JU1) removed.

The foregoing description is applicable to Function Stages No. 2, 3, and 4, when the appropriate function tone frequency is used, and the corresponding detector and bistable multivibrator stages are considered. Refer to the schematic diagram for specific details.

6. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing The Module In The Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A Printed Circuit Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing The Module Out Of The Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 13	Ground
11	Audio Oscillator input
12	A+ 13.6 volts dc

c. Module Malfunction Location Techniques

(1) Bistable Multivibrator

(a) Connect a dc voltmeter between pin 1 and the collector of Q4 (Q7, Q10, Q13).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1350 (1250, 1150, 1050) Hz. The voltmeter reading should fall to zero volts, indicating that the bistable multivibrator has changed state. If the change of state does not occur, check detector stage Q2 (Q5, Q8, Q11) then bistable multivibrator Q3-Q4 (Q6-Q7, Q9-Q10, Q12-Q13). If the change of state occurs, look to the function tone amplifier for a malfunction.

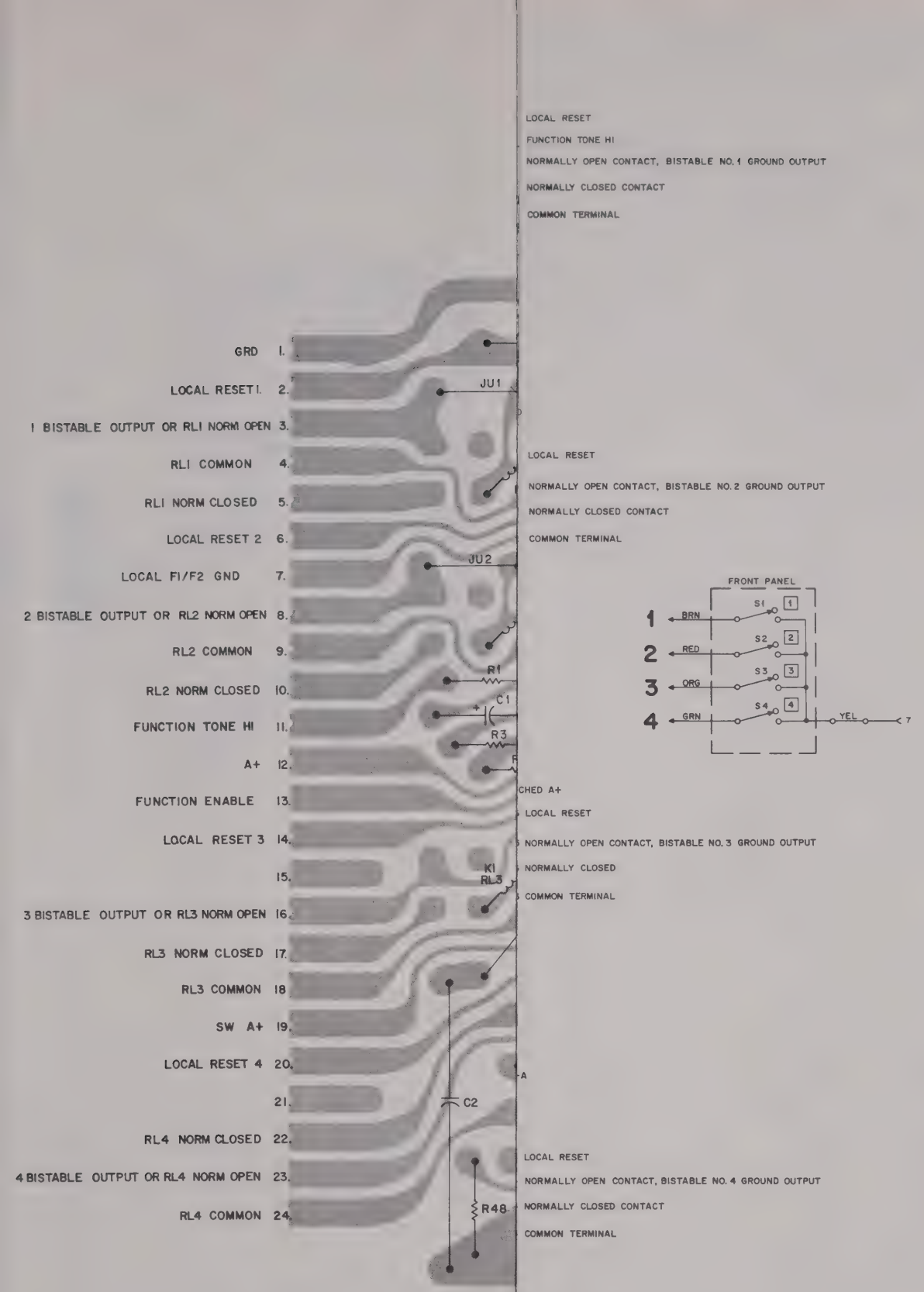
(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q1 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1200 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

(d) If the aforementioned conditions are not attained, measure the voltages on the function tone amplifier stage.



"WILD CARD" CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E14-B
1/2/70-UP

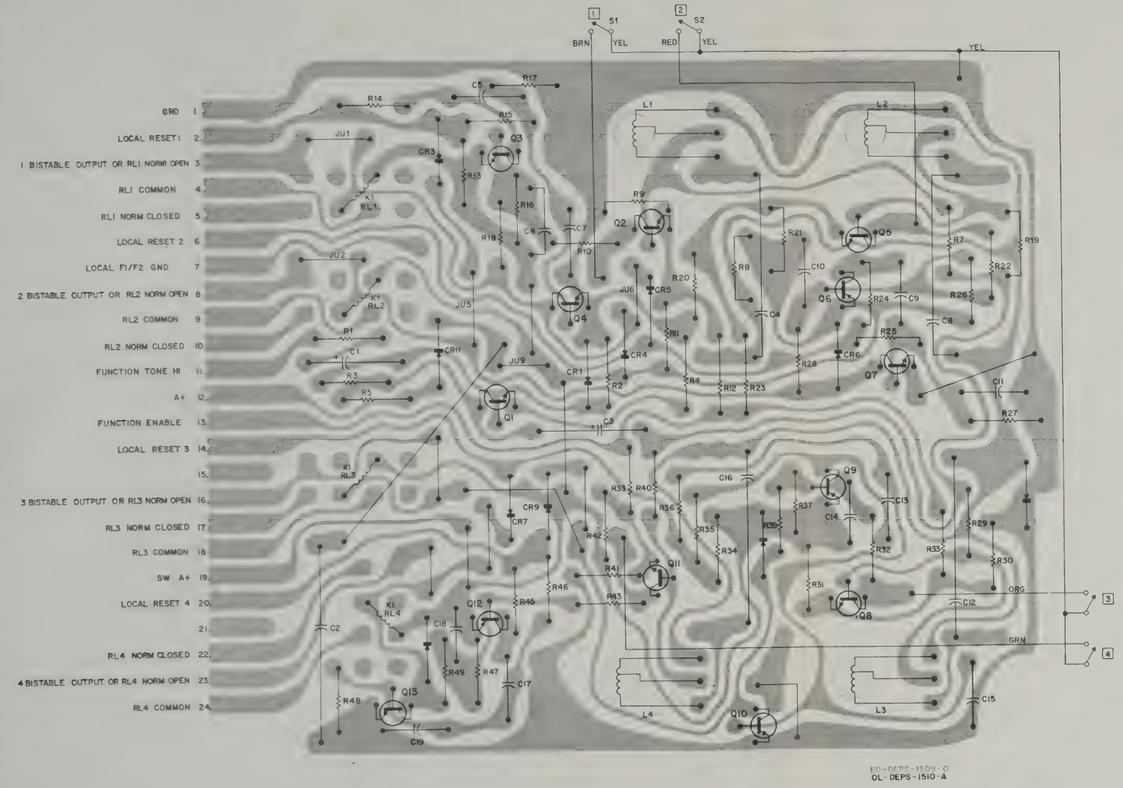
(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q1 to ground.

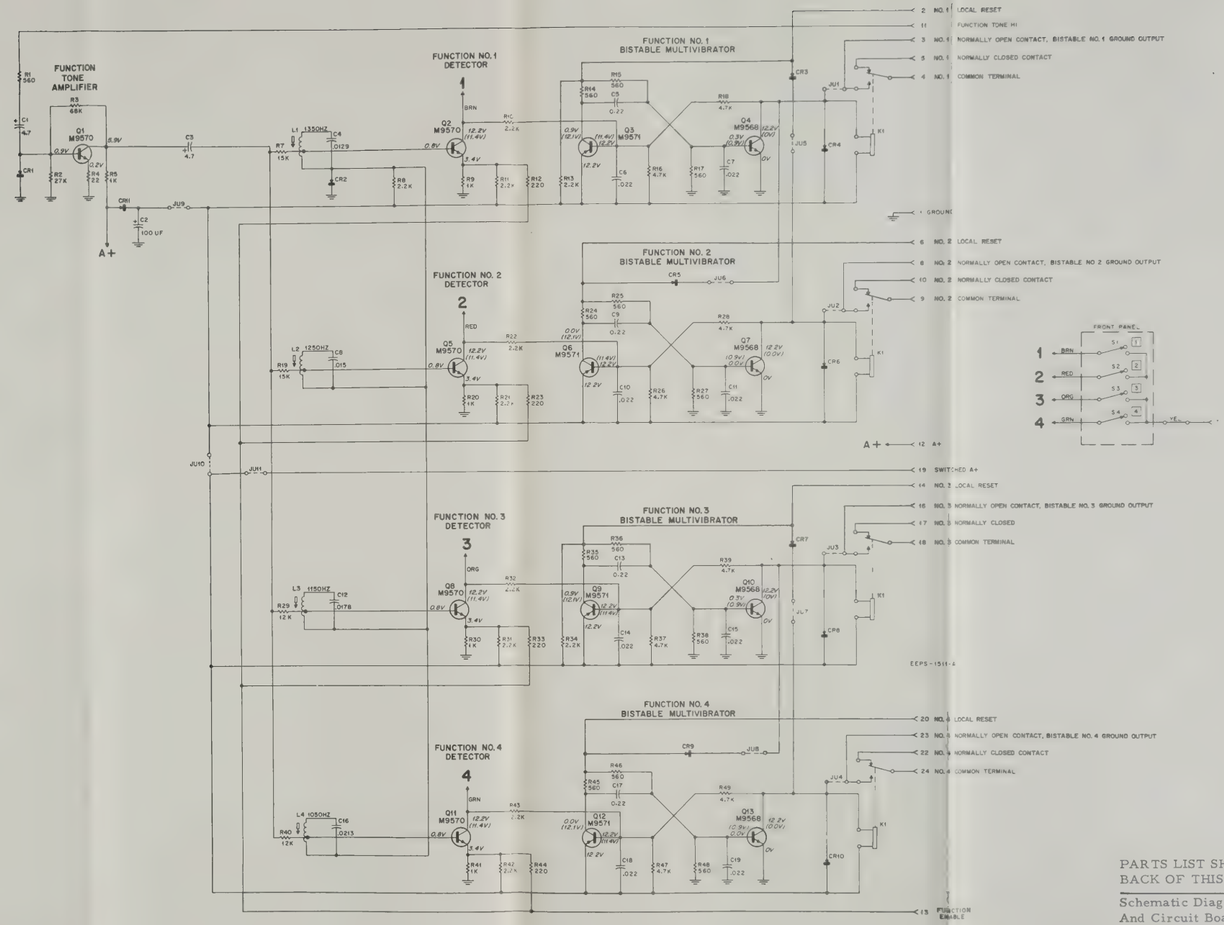
(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1200 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

(d) If the aforementioned conditions are not attained, measure the voltages on the function tone amplifier stage.



BD-DEPS-1509-C
OL-DEPS-1510-A


FUNCTION TONE AMPLIFIER
FUNCTION NO. 1 DETECTOR
FUNCTION NO. 1 BISTABLE MULTIVIBRATOR
FUNCTION NO. 2 DETECTOR
FUNCTION NO. 2 BISTABLE MULTIVIBRATOR
FUNCTION NO. 3 DETECTOR
FUNCTION NO. 3 BISTABLE MULTIVIBRATOR
FUNCTION NO. 4 DETECTOR
FUNCTION NO. 4 BISTABLE MULTIVIBRATOR
FRONT PANEL
2 NO. 1 LOCAL RESET
11 FUNCTION TONE HI
3 NO. 1 NORMALLY OPEN CONTACT, BISTABLE NO. 1 GROUND OUTPUT
5 NO. 1 NORMALLY CLOSED CONTACT
4 NO. 1 COMMON TERMINAL
1 GROUND
6 NO. 2 LOCAL RESET
8 NO. 2 NORMALLY OPEN CONTACT, BISTABLE NO. 2 GROUND OUTPUT
10 NO. 2 NORMALLY CLOSED CONTACT
9 NO. 2 COMMON TERMINAL
12 A+
19 SWITCHED A+
14 NO. 3 LOCAL RESET
16 NO. 3 NORMALLY OPEN CONTACT, BISTABLE NO. 3 GROUND OUTPUT
17 NO. 3 NORMALLY CLOSED
18 NO. 3 COMMON TERMINAL
20 NO. 4 LOCAL RESET
23 NO. 4 NORMALLY OPEN CONTACT, BISTABLE NO. 4 GROUND OUTPUT
22 NO. 4 NORMALLY CLOSED CONTACT
24 NO. 4 COMMON TERMINAL
13 FUNCTION ENABLE
EEPS-1511-A

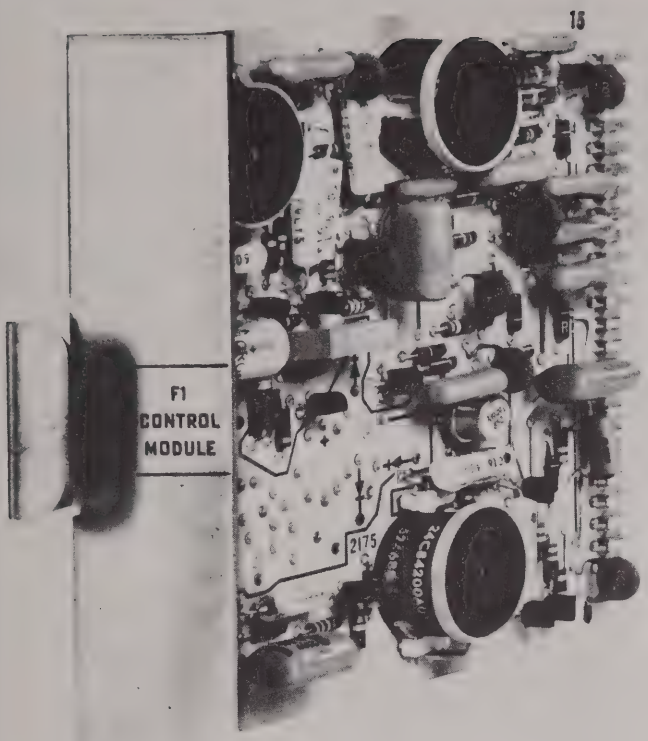
"WILD CARD" CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E14-B
1/2/70-UP

F1 CONTROL MODULE

MODEL TLN1243A



1. DESCRIPTION

The TLN1243A F1 Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module converts the proper tone signal from a remote control source to a grounding function to turn on the F1 channel element in the base station transmitter. The module contains notch-type audio filters to prevent spurious functions or responses.

3. CIRCUIT DESCRIPTION

In the quiescent state, all the function detectors are reverse-biased and cannot be turned on. When line push-to-talk occurs, power is applied to the F1 bistable multivibrator, Q3 and Q4, by the line control priority gate, Q5 and Q6. The bias switch, Q7, generates a function tone "window" which sets the operating bias on the F1 detector, Q2, and all other function control modules for about 375 milliseconds during line push-to-talk. Normally, the detectors are back-biated and cannot be turned on. A function tone entering on pin 14 passes through the transistor stage, Q1, operating at about a +16 dBm clipping level, which assures adequate drive to the detector stage.

When a 1950 Hz tone is received, it passes through the L1 and C4 network and into the F1 detector stage, Q2. When the tone is detected, it causes the F1 bistable multivibrator to change state, grounding the transmitter channel element via pin 3. This ground turns on the transmitter channel element and disables the Q7 detector bias switch, closing the function tone "window" to prevent the audio from falsely operating other function detectors with speech.

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

PARTS LIST

TLN4054A Wildcard Module Board — PL-473-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 V: unl stated
C1	23K865137	4.7 ±20%; 25 V
C2	23D82601A25	100 +150-10%; 20 V
C3	23K865137	4.7 ±20%; 25 V
C4	8D84326A20	.0129 ±2%
C5	8D82905G11	0.22
C6	8D82905G02	.022
C7	8D82905G02	.022
C8	8D84326A21	.015 ±2%
C9	8D82905G11	0.22
C10	8D82905G02	.022
C11	8D82905G02	.022
C12	8D84326A22	.0178 ±2%
C13	8D82905G11	0.22
C14	8D82905G02	.022
C15	8D82905G02	.022
C16	8D84326A33	.0213 ±2%
C17	8D82905G11	0.22
C18	8D82905G02	.022
C19	8D82905G02	.022
		SEMOCONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 11	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1 thru 4	1V80702B11	1 H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869570	N-P-N; M9570
Q3	48R869571	P-N-P; M9571
Q4	48R869568	N-P-N; M9568
Q6	48R869571	P-N-P; M9571
Q7	48R869568	N-P-N; M9568
Q8	48R869570	N-P-N; M9570
Q9	48R869571	P-N-P; M9571
Q10	48R869568	N-P-N; M9568
Q11	48R869570	N-P-N; M9570
Q12	48R869571	P-N-P; M9571
Q13	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 W; unl stated
R1	6S129620	560
R2	6S127806	27K
R3	6S129144	68K
R4	6S124A09	22 ±5%
R5	6S129805	1K ±5%
R7	6S129236	15K ±5%
R8	6S128689	2.2K
R9	6S129805	1K ±5%
R10	6S128689	2.2K
R11	6S129804	2.2K ±5%
R12	6S131275	220 ±5%
R13	6S128689	2.2K
R14	6S129620	560
R15	6S129620	560
R16	6S127804	4.7K
R17	6S129620	560
R18	6S127804	4.7K
R19	6S129236	15K ±5%
R20	6S129805	1K ±5%
R21	6S129804	2.2K ±5%
R22	6S128689	2.2K
R23	6S131275	220 ±5%
R24	6S129620	560
R25	6S129620	560
R26	6S127804	4.7K
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129887	12K ±5%
R30	6S129805	1K ±5%
R31	6S129804	2.2K ±5%
R32	6S128689	2.2K
R33	6S131275	220 ±5%
R34	6S128689	2.2K
R35	6S129620	560
R36	6S129620	560
R37	6S127804	4.7K
R38	6S129620	560
R39	6S127804	4.7K
R40	6S129887	12K ±5%
R41	6S129805	1K ±5%
R42	6S129804	2.2K ±5%
R43	6S128689	2.2K
R44	6S131275	220 ±5%
R45	6S129620	560
R46	6S129620	560
R47	6S127804	4.7K
R48	6S129620	560
R49	6S127804	4.7K

TLN4055A Wildcard Module Panel — PL-474-O

	1V80702B24	PANEL ASSEMBLY (riveted)
	45B83914G01	GUIDE, card: 2 used
	3S8022	SCREW, machine: #4-40 x 1/4": 2 used
	4S7683	LOCKWASHER: #4 Int.

TLN4151A Relay Kit — PL-455-O

K1	80C84201A01	RELAY, armature: 2 form "C", coil res. 200 ohms

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

TLN4054A Wildcard Module Board — PL-473-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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C3	23K865137	4.7 ±20%; 25 V
C4	8D84326A20	.0129 ±2%
C5	8D82905G11	0.22
C6	8D82905G02	.022
C7	8D82905G02	.022
C8	8D84326A21	.015 ±2%
C9	8D82905G11	0.22
C10	8D82905G02	.022
C11	8D82905G02	.022
C12	8D84326A22	.0178 ±2%
C13	8D82905G11	0.22
C14	8D82905G02	.022
C15	8D82905G02	.022
C16	8D84326A33	.0213 ±2%
C17	8D82905G11	0.22
C18	8D82905G02	.022
C19	8D82905G02	.022
		SEMOCONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 11	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1 thru 4	1V80702B11	1 H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869570	N-P-N; M9570
Q3	48R869571	P-N-P; M9571
Q4	48R869568	N-P-N; M9568
Q6	48R869571	P-N-P; M9571
Q7	48R869568	N-P-N; M9568
Q8	48R869570	N-P-N; M9570
Q9	48R869571	P-N-P; M9571
Q10	48R869568	N-P-N; M9568
Q11	48R869570	N-P-N; M9570
Q12	48R869571	P-N-P; M9571
Q13	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 W; unl stated
R1	6S129620	560
R2	6S127806	27K
R3	6S129144	68K
R4	6S124A09	22 ±5%
R5	6S129805	1K ±5%
R7	6S129236	15K ±5%
R8	6S128689	2.2K
R9	6S129805	1K ±5%
R10	6S128689	2.2K
R11	6S129804	2.2K ±5%
R12	6S131275	220 ±5%
R13	6S128689	2.2K
R14	6S129620	560
R15	6S129620	560
R16	6S127804	4.7K
R17	6S129620	560
R18	6S127804	4.7K
R19	6S129236	15K ±5%
R20	6S129805	1K ±5%
R21	6S129804	2.2K ±5%
R22	6S128689	2.2K
R23	6S131275	220 ±5%
R24	6S129620	560
R25	6S129620	560
R26	6S127804	4.7K
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129887	12K ±5%
R30	6S129805	1K ±5%
R31	6S129804	2.2K ±5%
R32	6S128689	2.2K
R33	6S131275	220 ±5%
R34	6S128689	2.2K
R35	6S129620	560
R36	6S129620	560
R37	6S127804	4.7K
R38	6S129620	560

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R39	6S127804	4.7K
R40	6S129887	12K ±5%
R41	6S129805	1K ±5%
R42	6S129804	2.2K ±5%
R43	6S128689	2.2K
R44	6S131275	220 ±5%
R45	6S129620	560
R46	6S129620	560
R47	6S127804	4.7K
R48	6S129620	560
R49	6S127804	4.7K

TLN4055A Wildcard Module Panel — PL-474-O

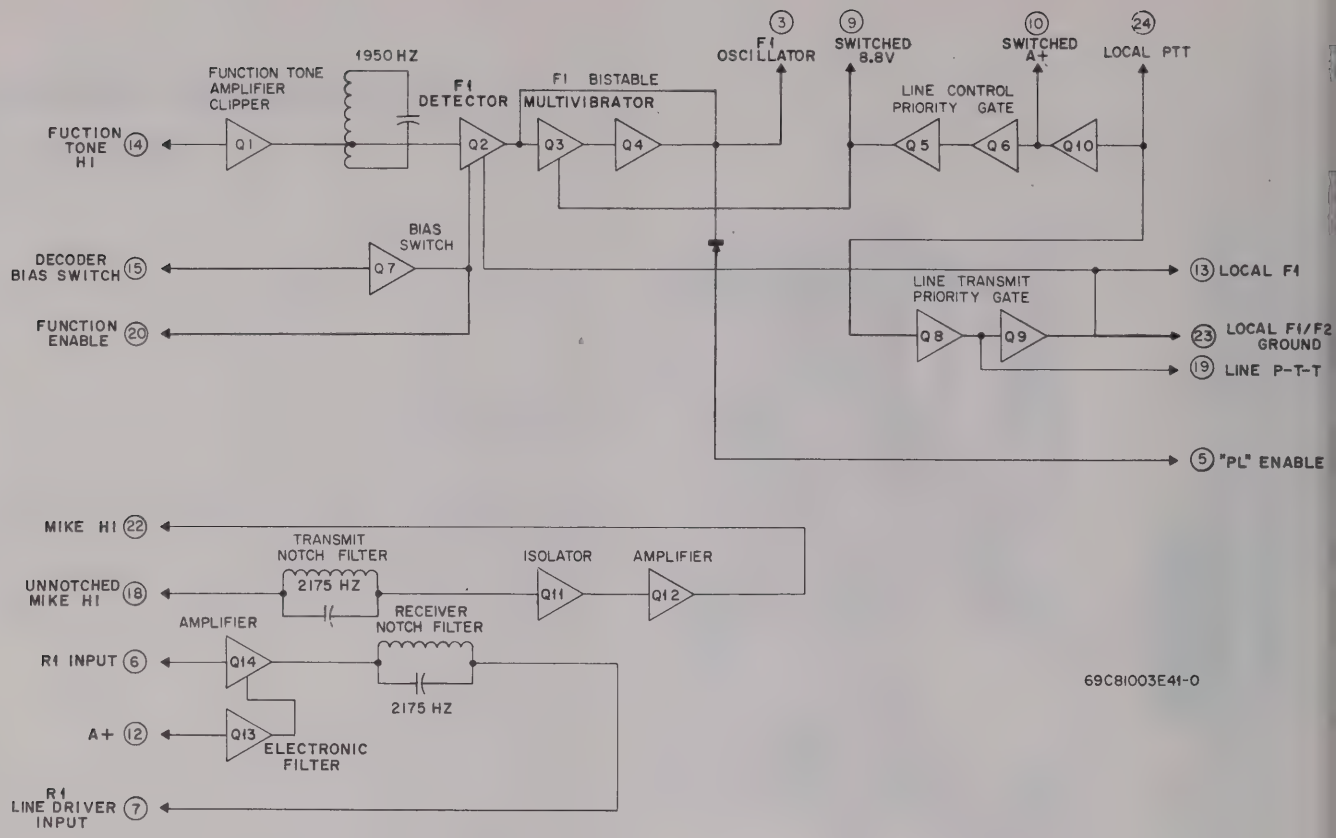
	1V80702B24	PANEL ASSEMBLY (riveted)
	45B83914G01	GUIDE, card: 2 used
	3S8022	SCREW, machine: #4-40 x 1/4": 2 used
	4S7683	LOCKWASHER: #4 Int.

TLN4151A Relay Kit — PL-455-O

K1	80C84201A01	RELAY, armature: 2 form "C", coil res. 200 ohms

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

Local transmission direct from the base station is controlled by applying a ground to the local P-T-T terminal, pin 24. This applies power to the F1 bistable multivibrator through transistors Q10, Q5, and Q6; and causes it to change state through the line transmit priority gate, Q8 and Q9.

If while a local transmission is being made, line push-to-talk occurs, the F1 bistable multivibrator is turned off by the sudden application of the line P-T-T and local transmit defeat, causing a momentary loss of switched 8.8 volts. After the line-controlled transmission is completed, the local transmission continues.

The receiver notch filter between the receiver terminal, pin 6, and the line driver input, pin 7, prevents the guard tone decoder from generating false responses from receiver noise or speech signals by removing all 2175 Hz components. The transmit notch filter, between pins 18 and 22, prevents the 2175 Hz guard tone from modulating a line-controlled transmission. Both notch filters have a notch depth greater than 45 dB at 2175 Hz. The electronic filter, Q13, and its associated components protect the receiver notch filter from any ripple appearing on the A+ line, which might disturb this very low level stage.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To initially determine the location of the fault, operate the station locally and initiate the desired function from the module. If the desired function occurs, the module is functioning properly. If it does not occur, the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and

reinsert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module:

PIN NUMBER	CONNECTION
1, 2, 4, 17	Ground
3	10K ohms to pin 12
5	10K ohms to pin 12
10	to pin 12
11	1000 ohms to ground; 200 ohms to pin 12
12	A+; 13.6 volts dc
14	audio oscillator input
18	4.7K ohms to ground; 4.7K ohms to pin 12; .1 uF to audio oscillator
20	to pin 1
23	100K ohms to pin 11

c. Normal Conditions

The following chart tabulates normal levels and values for proper operation of the F1 Control Module. Excessive deviation from these values indicates abnormal conditions.

Function	Typical Value
Overdrive level to F1 Detector @ 1950 Hz	9 dB
Switched 8.8-volt line	0 v dc (standby) 8 v dc (transmit)
F1 Tank Circuit Frequency	1950 Hz
F1 Pull-In Bandwidth (constant amplitude)	60 Hz
Transmit Notch Frequency	2175 Hz
Receive Notch Frequency	2175 Hz
Transmit Notch Depth	Greater than 45 dB
Receive Notch Depth	Greater than 45 dB
Transmit Notch Insertion loss @ 1kHz (pin 18 to pin 22)	0 dB
Receive Notch Insertion loss @ 1 kHz (pin 6 to pin 7)	2 dB

d. Stage Malfunction Location Techniques

(1) General

To locate a malfunction within the circuit module, a locally-injected signal may be applied to the input of a tone detector stage. If the tone causes the following bistable multivibrator to turn on, the preceding function tone amplifier stage should be investigated. If the bistable multivibrator does not turn on, the detector and multivibrator should be checked for proper voltages and operation.

(2) F1 Bistable Multivibrator

(a) Connect a dc voltmeter to the collector of Q4.

(b) Inject a 1950 Hz tone into tuned circuit L1 and C4 through a coupling capacitor at a level not exceeding 1 volt.

(c) If the voltage at the collector changes to the value indicated on the schematic diagram for the operated condition, the bistable multivibrator is functioning. Look to the function tone amplifier stage for a malfunction preventing proper operation of the module.

(3) Function Tone Amplifier Stage

(a) Connect an audio oscillator to pin 14 (high) and pin 1 (ground). Set the oscillator to 1000 Hz at -10 dBm.

(b) Measure the output level at the collector of Q1. The level should be at least +10 dBm. As viewed on an oscilloscope, the waveform should be well into a clipping condition.

(c) If the previous conditions cannot be obtained, check the voltages and components of the function tone amplifier stage.

(4) Transmit Notch Filter Stage

(a) Connect the biasing resistor network to pin 18 as indicated in the table.

(b) Connect an audio oscillator across pin 17 (low side) through a .1 uF capacitor to pin 18 (high side).

(c) Connect an ac voltmeter to pins 17 and 22 to measure the output as audio is injected from the oscillator.

(d) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltage at each frequency.

(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the transmit notch filter stage.

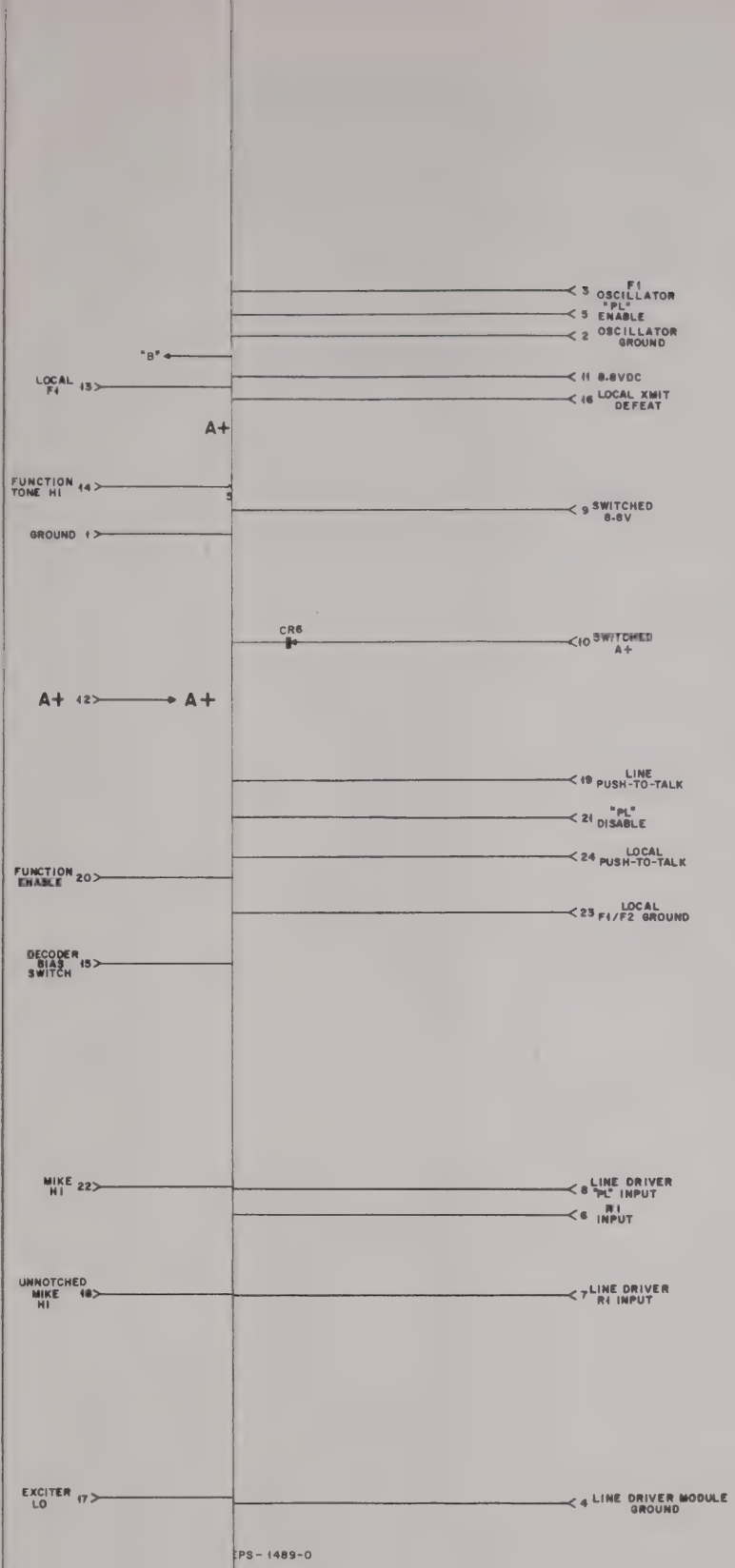
(5) Receiver Notch Filter Stage

(a) Connect an audio oscillator across pin 6 (high side) and ground.

(b) Connect an ac voltmeter between pin 7 and pin 4.

(c) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltages at each frequency.

(d) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the receiver notch filter stage.



F1 CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81004E87-A
1/2/70-UP

(d) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltage at each frequency.

(e) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the transmit notch filter stage.

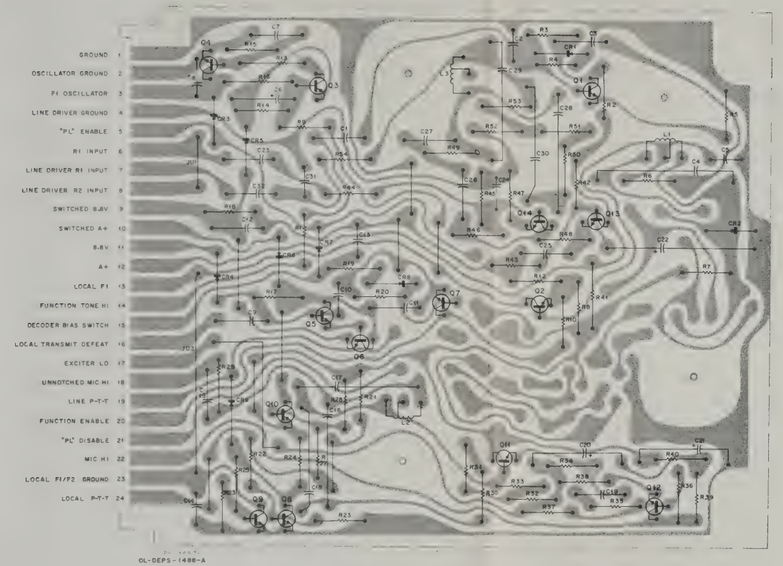
(5) Receiver Notch Filter Stage

(a) Connect an audio oscillator across pin 6 (high side) and ground.

(b) Connect an ac voltmeter between pin 7 and pin 4.

(c) Inject audio tones at a -20 dBm level at 1000, 1500, 2000, 2100, 2175, 2200, 2300, 2400, and 2500 Hz and measure the output voltages at each frequency.

(d) Minimum output should be measured at 2175 Hz, indicating the notch in the filter response. If the notch is not apparent, check voltages and components in the receiver notch filter stage.

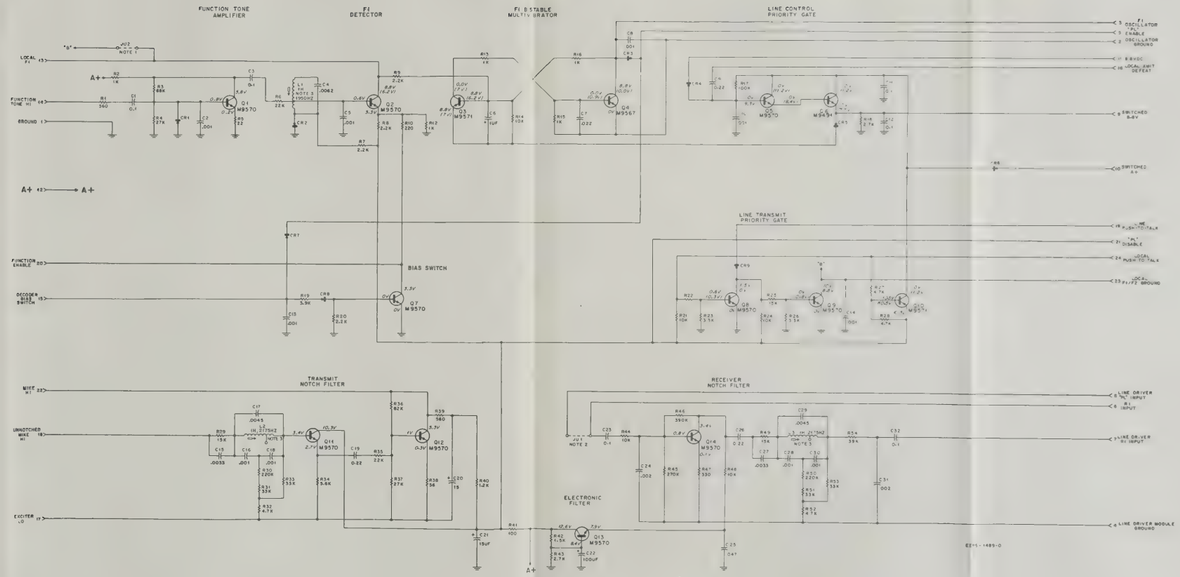


OL-DEPS-1488-A

NOTES:

1. JU2 REMOVED WHEN 2-FREQUENCY TRANSMITTERS ARE USED.
2. JU1 REMOVED EXCEPT ON 2-RECEIVER STATIONS WITHOUT 4-WIRE AUDIO, OR 2-RECEIVER STATIONS WITH SEPARATE TRANSMITTER AND RECEIVER AUDIO LINES.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.
4. VOLTAGES IN PARENTHESES ARE FOR ACTIVATED CONDITION.

EPS-2104-O



E91-1489-O

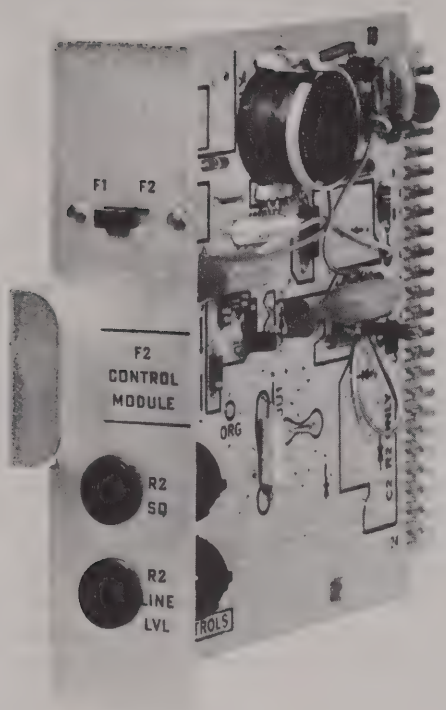
F1 CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81004E87-A
1/2/70-UP

F2 CONTROL MODULE

MODEL TLN1246A



1. DESCRIPTION

This is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

The module contains line level and squelch controls for a second receiver and circuitry for selection of the F2 transmit frequency. Frequency selection is performed with a 1850 Hz tone input from a remote source.

2. OPERATION

a. Line Operation

Normally, the F2 Control Module is activated by tone signals supplied over the wire control line from the remote control point to the base station. Signals are routed through the base station to the remote control chassis in which the control module is mounted, and into the module.

b. Local Operation

For local test purposes, functions of the module may be activated from the front panel of the module. To locally select the F2 frequency, move the F1-F2 slide switch to the F2 position. This will cause the F2 bistable multivibrator to change state and energize the F2 channel element. After the local transmission is made, the switched 8.8 volt supply to the bistable multivibrator is cut off, causing the bistable multivibrator to revert to its original state and shut off the F2 channel element.

IMPORTANT

DO NOT OPERATE F1-F2 SWITCH WHEN TRANSMITTER IS KEYED.

3. CIRCUIT DESCRIPTION

When a ground is applied to the function enable line, pin 13, and switched 8.8 volts is available at pin 8, the detector stage Q1, is operational. When operational, the detector will accept a signal from the amplifier stage, Q4.

A function tone entering the module on pin 11 passes to the amplifier stage, Q4, where it is

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ENGINEERING PUBLICATIONS 1301 W. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

PARTS LIST

TLN4038A "F1" Control Board — PL-440-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 50 v; unl. stated
C1, 3, 11, 12, 23, 32	8D82905G07	0.1
C2, 5, 8, 10, 13, 14	21D82187B29	.001; 100 v
C4	8D84326A14	.0062 ±2%
C6	23D82783B08	1 ±20%; 35 v
C7	8D82905G02	.022
C9, 19, 26	8D82905G11	0.22
C15, 27	8D82905G25	.0033
C16, 18, 28, 30	8C82284C01	.001
C17, 29	8C84326A30	.0045 ±1%
C20, 21	23K865136	15 ±20%; 25 v
C22	23D82601A25	100+150-10%; 20 v
C24, 31	21D82187B27	.002; 100 v
C25	8D82905G03	.047
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 9	48C82392B03	silicon
		REACTOR:
L1, 2, 3	1V80702B11	(factory-adjusted); res 40 ohms ±10%; includes grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 5, 7, 8, 9, 11, 12, 13, 14	48R869570	N-P-N; type M9570
Q3, 10	48R869571	P-N-P; type M9571
Q4	48R869567	N-P-N; type M9567
Q6	48R869491	N-P-N; type M9491
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129620	560
R2, 12	6S129805	1K ±5%
R3	6S129299	68K ±5%
R4	6S129886	27K ±5%
R5	6S124A09	22 ±5%
R6	6S129667	22K ±5%
R7, 20	6S128689	2.2K
R8, 9	6S129804	2.2K ±5%
R10	6S131275	220 ±5%
R13, 16	6S6229	1K; 1/2 w
R14, 21, 24, 44	6S129225	10K
R15	6S127802	1K
R17	6S129226	100K
R18, 43	6S128688	2.7K
R19	6S129232	3.9K
R22, 25, 29, 49	6S127805	15K
R23, 26	6S129231	3.3K
R27, 28	6S127804	4.7K
R30, 50	6S131858	220K ±5%
R31, 33, 51, 53	6S129526	33K ±5%
R32, 52	6S129669	4.7K ±5%
R34	6S129433	5.6K
R35	6S128685	22K
R36	6S129145	82K
R37	6S127806	27K
R38	6S124A19	56 ±5%
R39	6S129779	560 ±5%
R40	6S129235	1.2K
R41	6S6326	100; 1/2 w
R42	6S127803	1.5K
R45	6S131858	270K ±5%
R46	6S124D12	390K ±5%
R47	6S129806	330 ±5%
R48	6S129668	10K ±5%
R54	6S128903	39K

TLN4039A "F1" Control Panel — PL-439-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4038A "F1" Control Board PL-440-O

		CAPACITOR, fixed: uF; ±10%; 50 v; unl. stated
C1, 3, 11, 12, 23, 32	8D82905G07	0.1
C2, 5, 8, 10, 13, 14	21D82187B29	.001; 100 v
C4	8D84326A14	.0062 ±2%
C6	23D82783B08	1 ±20%; 35 v
C7	8D82905G02	.022
C9, 19, 26	8D82905G11	0.22
C15, 27	8D82905G25	.0033
C16, 18, 28, 30	8C82284C01	.001
C17, 29	8C84326A30	.0045 ±1%
C20, 21	23K865136	15 ±20%; 25 v
C22	23D82601A25	100+150-10%; 20 v
C24, 31	21D82187B27	.002; 100 v
C25	8D82905G03	.047
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 9	48C82392B03	silicon
		REACTOR:
L1, 2, 3	1V80702B11	(factory-adjusted); res 40 ohms ±10%; includes grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 5, 7, 8, 9, 11, 12, 13, 14	48R869570	N-P-N; type M9570
Q3, 10	48R869571	P-N-P; type M9571
Q4	48R869567	N-P-N; type M9567
Q6	48R869491	N-P-N; type M9491
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129620	560
R2, 12	6S129805	1K ±5%
R3	6S129299	68K ±5%
R4	6S129886	27K ±5%
R5	6S124A09	22 ±5%
R6	6S129667	22K ±5%
R7, 20	6S128689	2.2K
R8, 9	6S129804	2.2K ±5%
R10	6S131275	220 ±5%
R13, 16	6S6229	1K; 1/2 w
R14, 21, 24, 44	6S129225	10K
R15	6S127802	1K
R17	6S129226	100K
R18, 43	6S128688	2.7K
R19	6S129232	3.9K
R22, 25, 29, 49	6S127805	15K
R23, 26	6S129231	3.3K
R27, 28	6S127804	4.7K
R30, 50	6S131858	220K ±5%
R31, 33, 51, 53	6S129526	33K ±5%
R32, 52	6S129669	4.7K ±5%
R34	6S129433	5.6K
R35	6S128685	22K
R36	6S129145	82K
R37	6S127806	27K
R38	6S124A19	56 ±5%
R39	6S129779	560 ±5%
R40	6S129235	1.2K
R41	6S6326	100; 1/2 w
R42	6S127803	1.5K
R45	6S131858	270K ±5%
R46	6S124D12	390K ±5%
R47	6S129806	330 ±5%
R48	6S129668	10K ±5%
R54	6S128903	39K

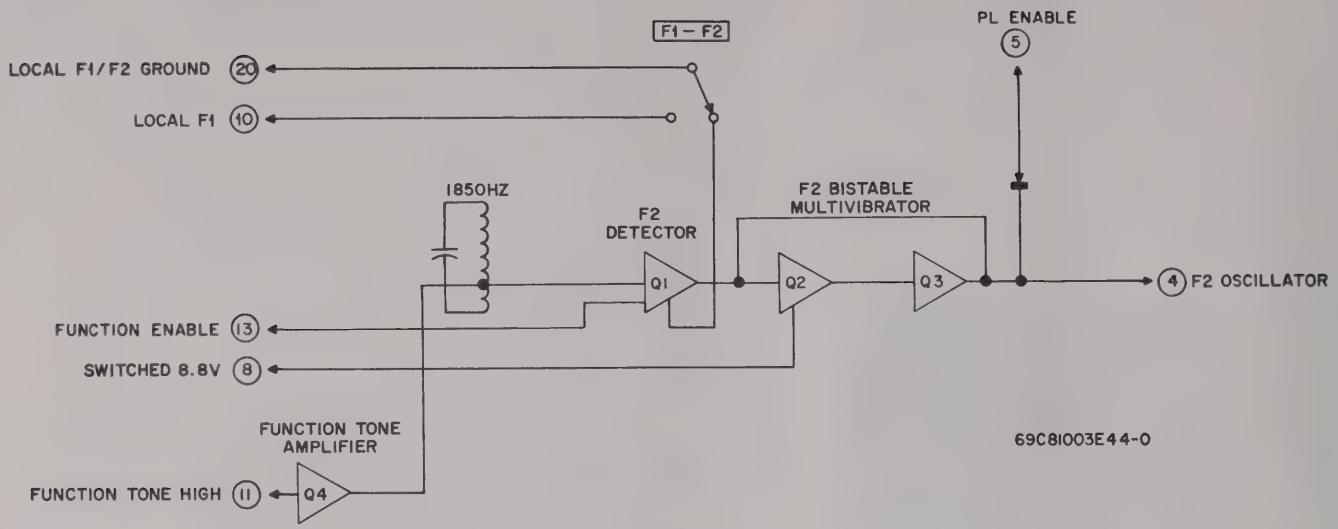
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN4039A "F1" Control Panel PL-439-O

NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

amplified and clipped to a +16 dBm level. This level assures adequate drive to the succeeding detector stage. From the amplifier stage, the tone enters the tuned circuit, L1 and C1, which will pass only a 1850 Hz tone into Q1. When the tone is detected in transistor Q1, it causes the bistable multivibrator to change state and apply a ground to the F2 channel element via pin 4. This turns on the channel element for the F2 frequency for the duration of the transmission.

At the end of the transmission, the switched 8.8 volts is removed, the bistable multivibrator reverts to its initial condition, and the F2 channel element is turned off.

Controls for the station second receiver are included on the circuit board. Potentiometer R18 adjusts the line level output from the receiver, while potentiometer R16 sets the squelch threshold level for the second receiver.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To initially determine the location of the fault, operate the station locally and initiate the desired function from the module. If the desired function occurs, the module is functioning properly. If the function does not occur, the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access, remove the module, insert a Model TLN8799A PC Service Board and reinsert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module:

PIN NUMBER	CONNECTION
1, 2, 13	Ground
4	10K ohms to pin 12
5	10K ohms to pin 12
8	to pin 12
11	oscillator input
12	A+ 13.6 volts dc

c. Normal Conditions

The following chart tabulates normal levels and values for proper operation of the F2 control module. Excessive deviation from these values indicates abnormal conditions in the module.

FUNCTION	TYPICAL VALUE
F2 Tank Circuit Frequency	1850 Hz
F2 Pull-in Bandwidth (constant amplitude)	60 Hz
F2 Detector Overdrive @ 1850 Hz	9 dB

d. Module Malfunction Location Techniques

(1) F2 Bistable Multivibrator

(a) Connect a dc voltmeter across pin 4 and pin 2.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1850 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage, Q1, then the bistable multivibrator, Q2 and Q3. If the change of state occurs, look to the function tone amplifier for a malfunction.

(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q4 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1800 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilliscope, the waveform should be well into a clipped condition.

(d) If the previous conditions are not attained, measure the voltages on the function tone detector stage.

GROUND 1

CHANNEL ELEMENT GROUND 2

3

F2 CHANNEL ELEMENT 4

"PL" ENABLE 5

F1 CHANNEL ELEMENT 6

R2 MUTE 7

SWITCHED 8.8V 8

9

LOCAL F1 10

TION TONE HI 11

A+ 12

FUNCTION ENABLE 13

"PL" TONE INHIBIT 14

R1 OSCILLATOR 15

RECEIVER OSCILLATOR GROUND 16

R2 OSCILLATOR 17

18

19

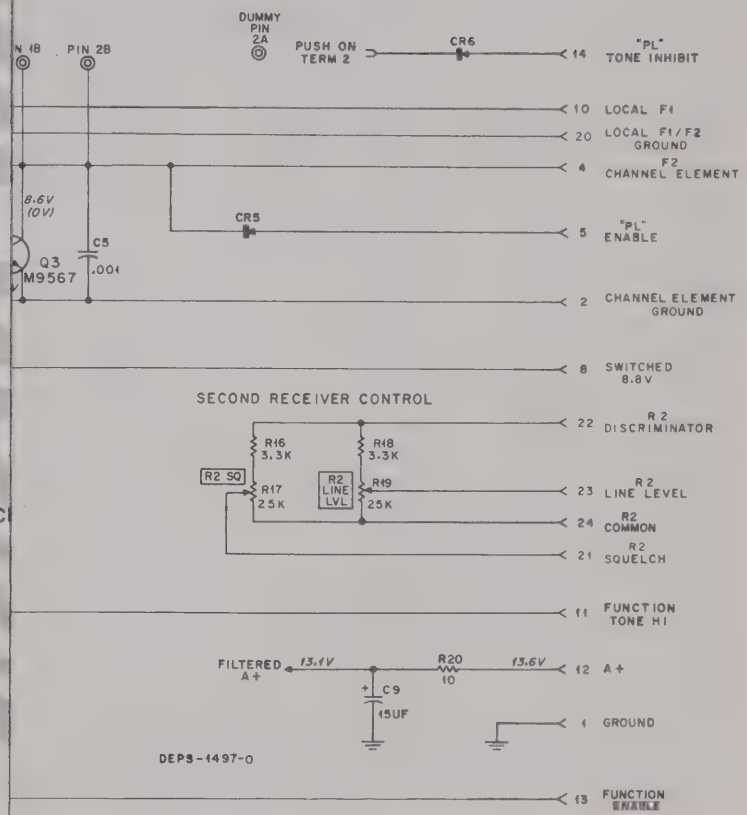
LOCAL F1/F2 GROUND 20

R2 SQUELCH 21

R2 DISCRIMINATOR 22

R2 LINE LEVEL 23

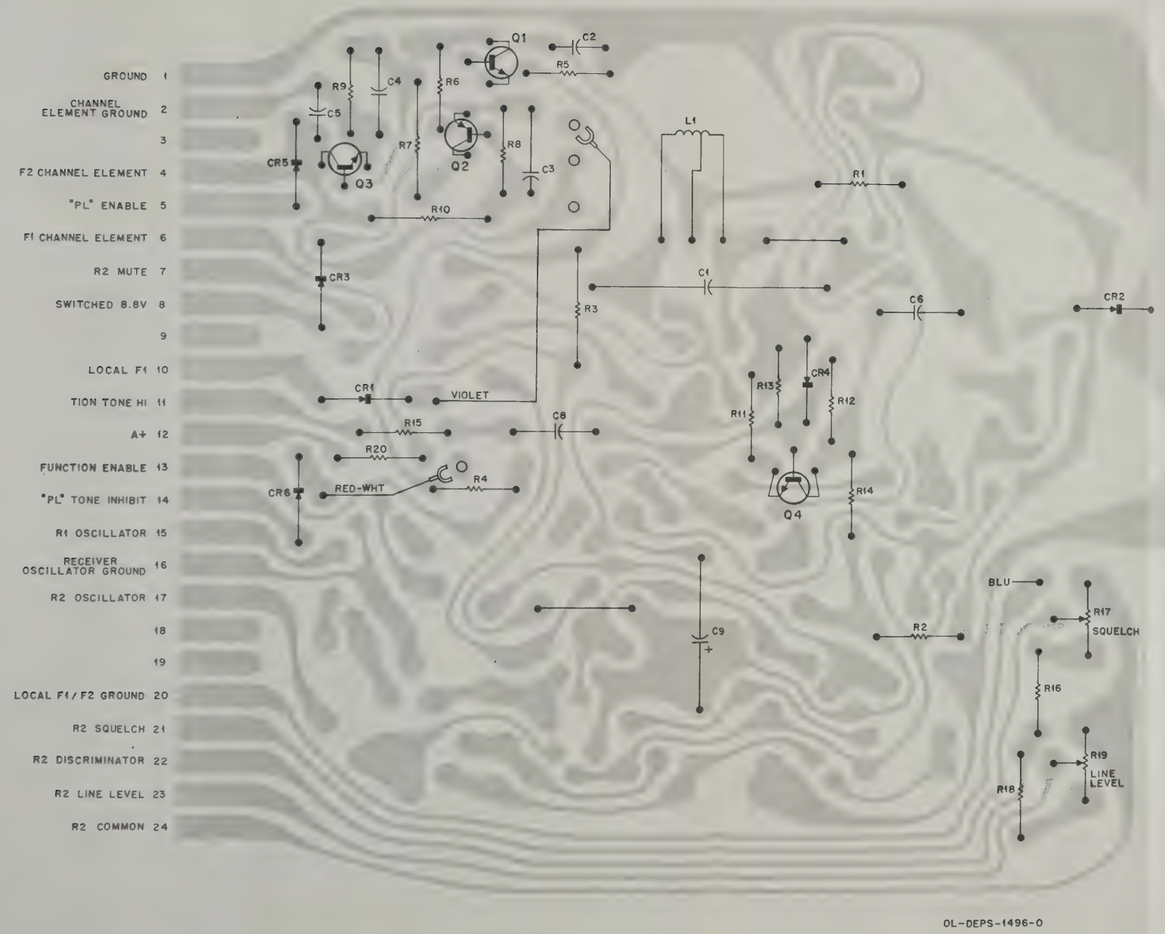
R2 COMMON 24

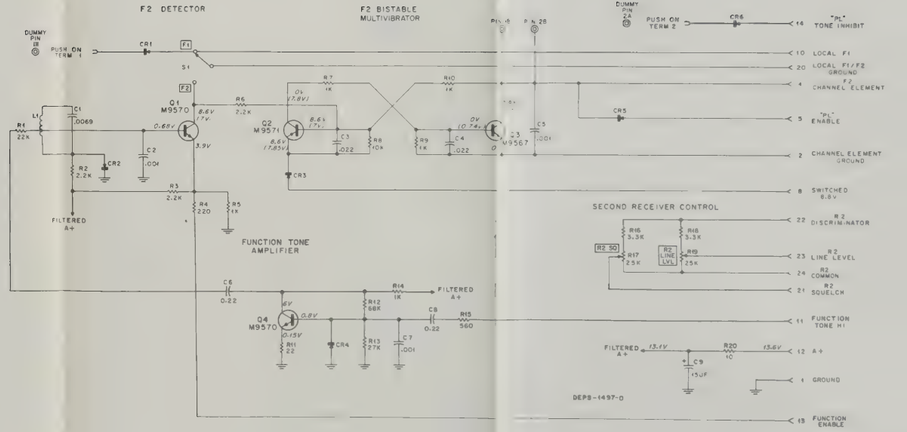


F2 CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E94-O
5/17/69-CP





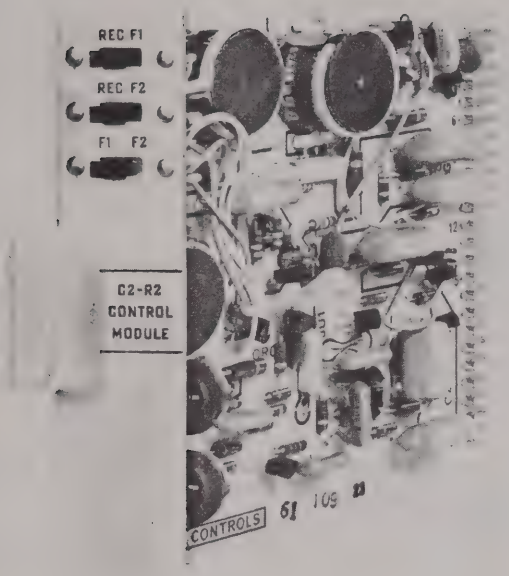
F2 CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E94-O
5/17/69-CP

C2-R2 CONTROL MODULE

MODEL TLN1248A



1. DESCRIPTION

The TLN1248A C2-R2 Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module provides selection of either of two receive frequencies or the simultaneous selection of the second transmit and receive frequencies (T2 and R2) by tone command from a remote control point. A 1750 Hz tone selects the R1 frequency, a 1650 Hz tone selects the R2 frequency, and an 1850 Hz tone selects the T2 and R2 frequencies. Also, selection of either transmit frequency will set up the corresponding receive frequency after the transmission is made.

3. CIRCUIT DESCRIPTION

a. Selection of R1 Receive Frequency

A 1750 Hz tone present on pin 11 is amplified and clipped in the tone amplifier stage, Q4. After amplification and clipping, the tone passes through the tuned circuit, L2 and C10, and on to the detector stage Q5. With detection, the bistable multivibrator, Q6 and Q7, is activated which applies a positive input to the base of the receive R1 switch transistor, Q11. With this input, the receive R1 switch applies a ground to the R1 channel element through pin 15 which activates the receiver R1 frequency.

When the Q6 and Q7 bistable multivibrator turns on, the R2 mute bistable multivibrator, Q9 and Q10, is disabled which removes the drive from the base of the receive R2 switch transistor, Q12. Upon removal of the base drive from Q12, the ground is removed from the R2 channel element which disables the receiver R2 frequency.

b. Selection of R2 Receive Frequency

A 1650 Hz tone from the remote control point entering on pin 11 is amplified and clipped in the tone amplifier stage, Q4. After amplification and clipping, the tone passes through the tuned circuit, L3 and C16 into the detector stage, Q8. With detection, the bistable multivibrator, Q9 and Q10 is activated which applies a positive input to the base of the receive R2 switch Q12. With this input, the receive R2 switch applies a ground to the R2 channel element through pin 17 which activates the receiver R2 frequency.

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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4044A F2 Decoder Board — PL-483-O

		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82095G11	0.22
C9	23K865136	15 ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 6	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	variable; 25K
R18	6S129231	3.3K
R19	18C83083G03	variable; 25K
R20	6S129755	10
	NON-REFERENCED ITEM	
	42S10217A01	STRAP, cable harness

TLN4045A F2 Decoder Panel Kit — PL-496-O

S1	40B83204B01	SWITCH, slide: dpdt
	NON-REFERENCED ITEMS	
	1V80702B17	PANEL ASSY. (riveted); incl. ref. part S1
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4044A F2 Decoder Board — PL-483-O

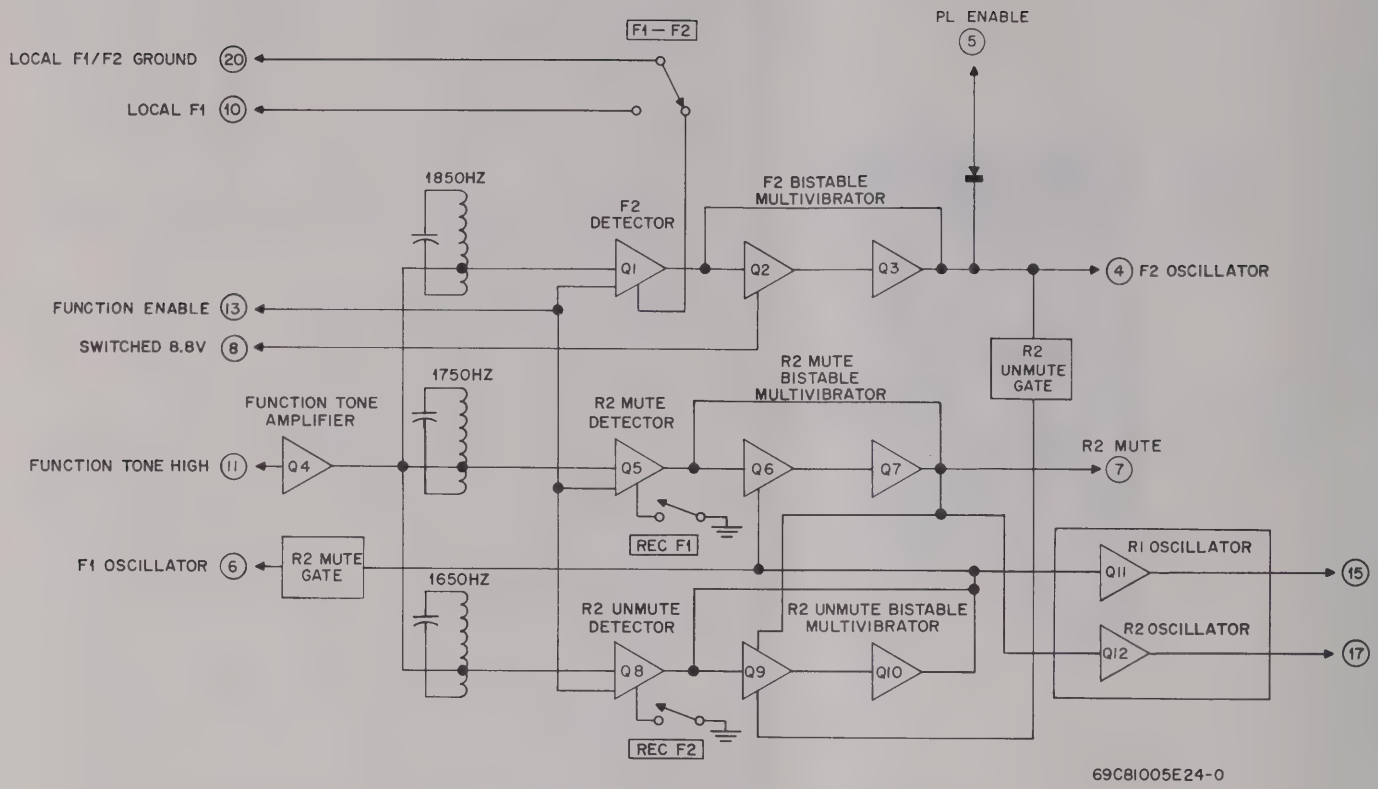
		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82095G11	0.22
C9	23K865136	15 ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 6	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	variable; 25K
R18	6S129231	3.3K
R19	18C83083G03	variable; 25K
R20	6S129755	10
NON-REFERENCED ITEM		
	42S10217A01	STRAP, cable harness

TLN4045A F2 Decoder Panel Kit — PL-496-O

S1	40B83204B01	SWITCH, slide: dpdt
NON-REFERENCED ITEMS		
	1V80702B17	PANEL ASSY. (riveted); incl. ref. part S1
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

When the Q9 and Q10 bistable multivibrator turns on, the R2 mute bistable multivibrator, Q6 and Q7, is turned off by a positive pulse sent from the Q9 collector circuit through diode CR9 to the collector of Q7. This interlocks the R2 mute and R2 unmute bistable multivibrators to prevent simultaneous operation of both.

c. Selection of F2 Transmit and Receive Frequency

An 1850 Hz tone applied to pin 11 is amplified and clipped in the tone amplifier stage, Q4. After amplification and clipping, the tone will pass through the tuned circuit, L1-C1, and into the tone detector Q1. Upon detection it triggers the F2 bistable multivibrator, Q2-Q3, to turn it on. When the multivibrator turns on, the collector of Q3 goes to ground potential and applies a ground to module pin 4 which applies a ground to the F2 channel element.

When the Q2-Q3 multivibrator turns on, a negative-going transient pulse is coupled through capacitor C21 and diode CR11 to the R2 unmute bistable multivibrator. When the R2 unmute bistable multivibrator, Q9-Q10, is triggered, the R2 mute and receive R2 switch circuits are operated as described in the preceding paragraphs under "Selection of R2 Receive Frequency".

d. Activation of R1 Receive Frequency when F1 is Selected

When a 1950 Hz tone command is sent to the system to select the F1 channel, the T1 channel element receives an activating ground. This ground appears at pin 6 of the module and induces a negative transient through capacitor C15, resistor R30, and diode CR8. This pulse causes the R2 mute bistable multivibrator to turn on which applies a positive output to the receive R1 switch stage, Q11 via the Q9 and Q10 bistable multivibrator. The

output causes the transistor, Q11, to saturate, applying a ground to the R1 channel element via pin 15, turning the F1 receive frequency on.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To initially determine the location of the fault, operate the station locally and initiate the desired function tone from the module. If the desired function occurs, the module is functioning properly. If the function does not occur, the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and reinsert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module:

PIN NUMBER	CONNECTION
1, 2, 13	Ground
4	10K ohms to pin 12
5	10K ohms to pin 12
8	to pin 12
11	Oscillator input
12	A+; 13.6 volts dc
15	10K ohms to pin 12
16	to ground
17	10K ohms to pin 12

c. Module Malfunction Location Techniques

(1) F2 Control Stages

(a) Connect a dc voltmeter across pin 4 and pin 2.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1850 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage, Q1, then the bistable multivibrator, Q2 and Q3. If the change of state occurs, look to the function tone amplifier for a malfunction.

(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q4 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1800 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

(d) If the previous conditions are not attained, measure the voltages on the function tone detector stage.

(3) R2 Mute Stages

(a) Connect a dc voltmeter across the collector of transistor Q7 and ground (pin 1).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q5. The output level must not exceed 1 volt.

(c) Adjust the oscillator frequency to 1750 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage, Q5, then the bistable multivibrator, Q6 and Q7. If the change of state occurs, look to the function tone amplifier for a malfunction.

(4) R2 Unmute Stages

(a) Connect a dc voltmeter across the collector of transistor Q10 and ground (pin 1).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q8. The output level from the oscillator must not exceed 1 volt.

(c) Adjust the oscillator frequency to 1650 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the multivibrator does not change state, check the detector stage, Q8, then the bistable multivibrator, Q9 and Q10. If the change of state occurs, check the R2 mute stages as previously described.

(5) Receive R1 Switch Stage

(a) Connect a dc voltmeter from the collector of Q11 to ground (pin 16).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q5. The output level from the oscillator must not exceed 1 volt.

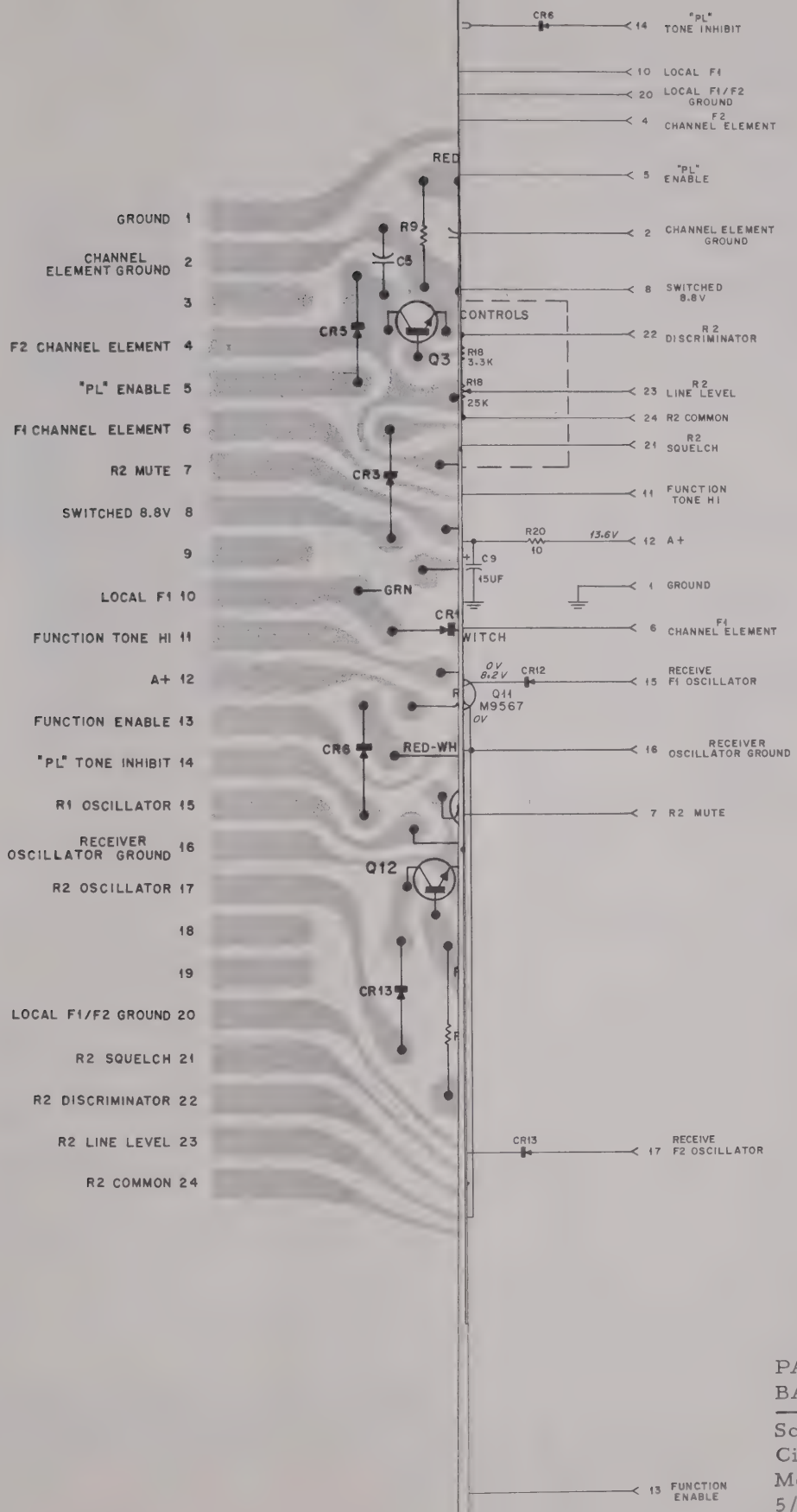
(c) Adjust the oscillator frequency to 1750 Hz. The voltmeter reading should fall to zero volts, indicating that the receive R1 switch is operating. If the switch does not operate, check the Q11 stage, then the bistable multivibrator, Q6 and Q7 stage, and the detector stage, Q5.

(6) Receive R2 Switch Stage

(a) Connect a dc voltmeter from the collector of Q12 to ground (pin 16).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q8. The output level from the oscillator must not exceed 1 volt.

(c) Adjust the oscillator frequency to 1650 Hz. The voltmeter reading should fall to zero volts, indicating that the receive R2 switch is operating. If the switch does not operate, check the Q12 stage, then the bistable multivibrator stage, Q9 and Q10, and the detector stage, Q8.



C2-R2 CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E99-O
5/17/69-CP

(c) Adjust the oscillator frequency to 1650 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the multivibrator does not change state, check the detector stage, Q8, then the bistable multivibrator, Q9 and Q10. If the change of state occurs, check the R2 mute stages as previously described.

(5) Receive R1 Switch Stage

(a) Connect a dc voltmeter from the collector of Q11 to ground (pin 16).

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q5. The output level from the oscillator must not exceed 1 volt.

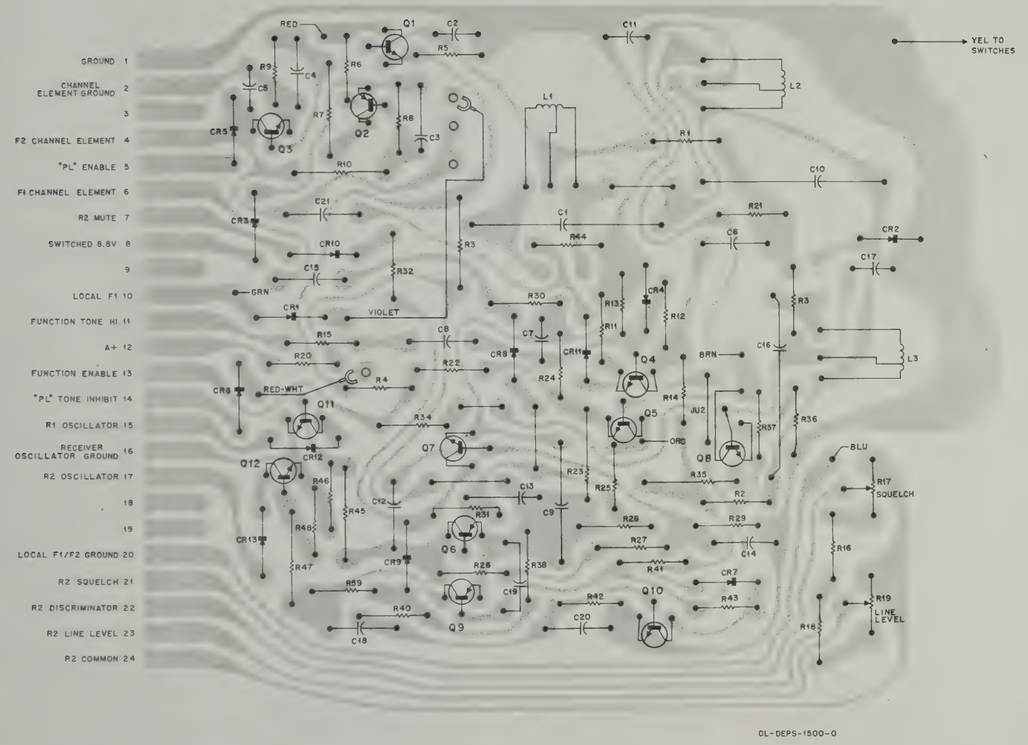
(c) Adjust the oscillator frequency to 1750 Hz. The voltmeter reading should fall to zero volts, indicating that the receive R1 switch is operating. If the switch does not operate, check the Q11 stage, then the bistable multivibrator, Q6 and Q7 stage, and the detector stage, Q5.

(6) Receive R2 Switch Stage

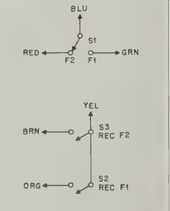
(a) Connect a dc voltmeter from the collector of Q12 to ground (pin 16).

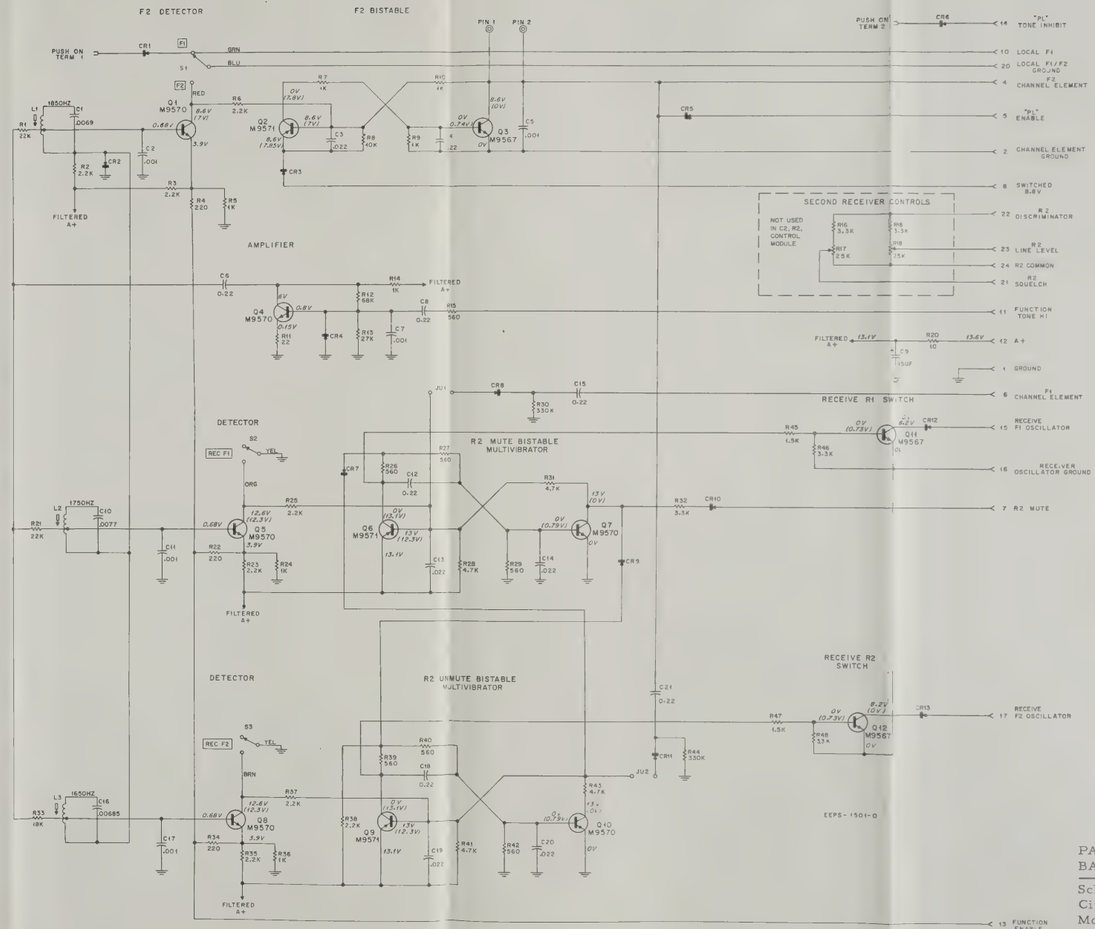
(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q8. The output level from the oscillator must not exceed 1 volt.

(c) Adjust the oscillator frequency to 1650 Hz. The voltmeter reading should fall to zero volts, indicating that the receive R2 switch is operating. If the switch does not operate, check the Q12 stage, then the bistable multivibrator stage, Q9 and Q10, and the detector stage, Q8.



OL-DEPS-1500-O





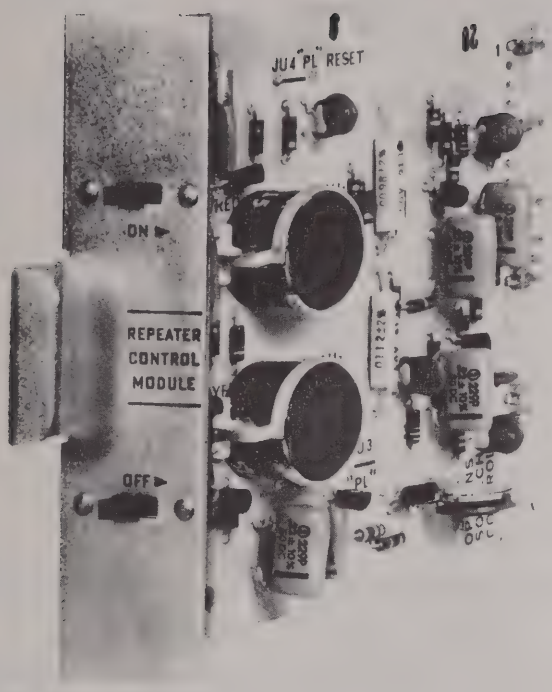
PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81004E99-O
5/17/69-CP

C2,R2 CONTROL MODULE

REPEATER CONTROL MODULE

MODEL TLN1250A



1. DESCRIPTION

The TLN1250A Repeater Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module provides functions to control the turning on or off of repeater operation. A 1450 Hz tone command originating from a remote control point activates circuitry on the module to cause the repeater operation to be activated ("set up"); a 1550 Hz tone command causes the repeater operation to be deactivated ("turnoff").

3. CIRCUIT DESCRIPTION

A 1550 Hz tone entering the module on pin 11 is amplified and clipped in the amplifier stage (Q1). From the Q1 stage, the tone passes through the tuned circuit (L1-C4) and into the Q2 stage, where it is detected. Upon detection, the Repeater Turnoff Bistable Multivibrator (Q3-Q4) is triggered, applying a ground to pin 9.

When the bistable multivibrator (Q3-Q4) is triggered, the negative-going pulse generated is applied through diode CR5 to the Repeater Setup Bistable Multivibrator (Q6-Q7), causing it to turn off so that the repeater function cannot be turned on.

When a 1450 Hz tone is applied to the module from a remote control point, it passes through the function tone amplifier stage (Q1) as before, but it can only enter the tuned circuit (L2-C10) which is resonant at 1450 Hz. Passing through the tuned circuit, the tone is detected in the detector stage (Q5) which causes the Repeater Setup Bistable Multivibrator to change state. When the change occurs, the collector of Q7 goes to ground potential. As this occurs, a negative pulse is coupled through diode CR6 to the Repeater Turnoff Bistable Multibivator (Q3-Q4). The multivibrator is forced to return to its off state. When the multivibrator returns to its off state, the ground is removed from pin 9 of the module, allowing the repeater operation to function once again.

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 W. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

PARTS LIST

TLN4048A C2-R2 Decoder Board — PL-481-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82905G11	0.22
C9	23K865136	15 ±20%; 25 v
C10	8D84326A16	.0077 ±2%
C11	21D82187B29	.001; 100 v
C12	8D82905G11	0.22
C13	8D82905G02	.022
C14	8D82905G02	.022
C15	8D82905G11	0.22
C16	8D84326A17	.00865 ±2%
C17	21D82187B29	.001; 100 v
C18	8D82905G11	0.22
C19	8D82905G02	.022
C20	8D82905G02	.022
C21	8D82905G11	0.22
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 13	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1 thru 3	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
Q5	48R869570	N-P-N; M9570
Q6	48R869571	P-N-P; M9571
Q7	48R869570	N-P-N; M9570
Q8	48R869570	N-P-N; M9570
Q9	48R869571	P-N-P; M9571
Q10	48R869570	N-P-N; M9570
Q11	48R869567	N-P-N; M9567
Q12	48R869567	N-P-N; M9567
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	var: 25K
R18	6S129231	3.3K
R19	18C83083G03	var; 25K
R20	6S129755	10
R21	6S129667	22K ±5%
R22	6S131275	220 ±5%
R23	6S2028	2.2K ±5%; 1/2 w
R24	6S129805	1K ±5%
R25	6S128689	2.2K
R26	6S129620	560
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129620	560
R30	6S129228	330K
R31	6S127804	4.7K
R32	6S129231	3.3K
R33	6S131526	18K ±5%
R34	6S131275	220 ±5%
R35	6S2028	2.2K ±5%; 1/2 w
R36	6S129805	1K ±5%
R37	6S128689	2.2K
R38	6S128689	2.2K
R39	6S129620	560
R40	6S129620	560
R41	6S127804	4.7K
R42	6S129620	560
R43	6S127804	4.7K
R44	6S129228	330K
R45	6S6038	1.5K; 1/2 w
R46	6S129231	3.3K
R47	6S6038	1.5K; 1/2 w
R48	6S129231	3.3K
		NON-REFERENCED ITEM
	42S10217A01	STRAP, cable harness

TLN4049A C2-R2 Decoder Panel Kit — PL-482-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SWITCH, slide:
S1	40B83204B01	dpdt
S2	40B83468E01	spdt
S3	40B83468E01	spdt
		NON-REFERENCED ITEMS
	1V80703B19	PANEL ASSY (riveted); incl. ref parts S1, S2 and S3
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

TLN4048A C2-R2 Decoder Board — PL-481-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82905G11	0.22
C9	23K865136	15 ±20%; 25 v
C10	8D84326A16	.0077 ±2%
C11	21D82187B29	.001; 100 v
C12	8D82905G11	0.22
C13	8D82905G02	.022
C14	8D82905G02	.022
C15	8D82905G11	0.22
C16	8D84326A17	.00865 ±2%
C17	21D82187B29	.001; 100 v
C18	8D82905G11	0.22
C19	8D82905G02	.022
C20	8D82905G02	.022
C21	8D82905G11	0.22
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 13	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1 thru 3	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
Q5	48R869570	N-P-N; M9570
Q6	48R869571	P-N-P; M9571
Q7	48R869570	N-P-N; M9570
Q8	48R869570	N-P-N; M9570
Q9	48R869571	P-N-P; M9571
Q10	48R869570	N-P-N; M9570
Q11	48R869567	N-P-N; M9567
Q12	48R869567	N-P-N; M9567
		RESISTOR, fixed: ±10%; 1/4 w: unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
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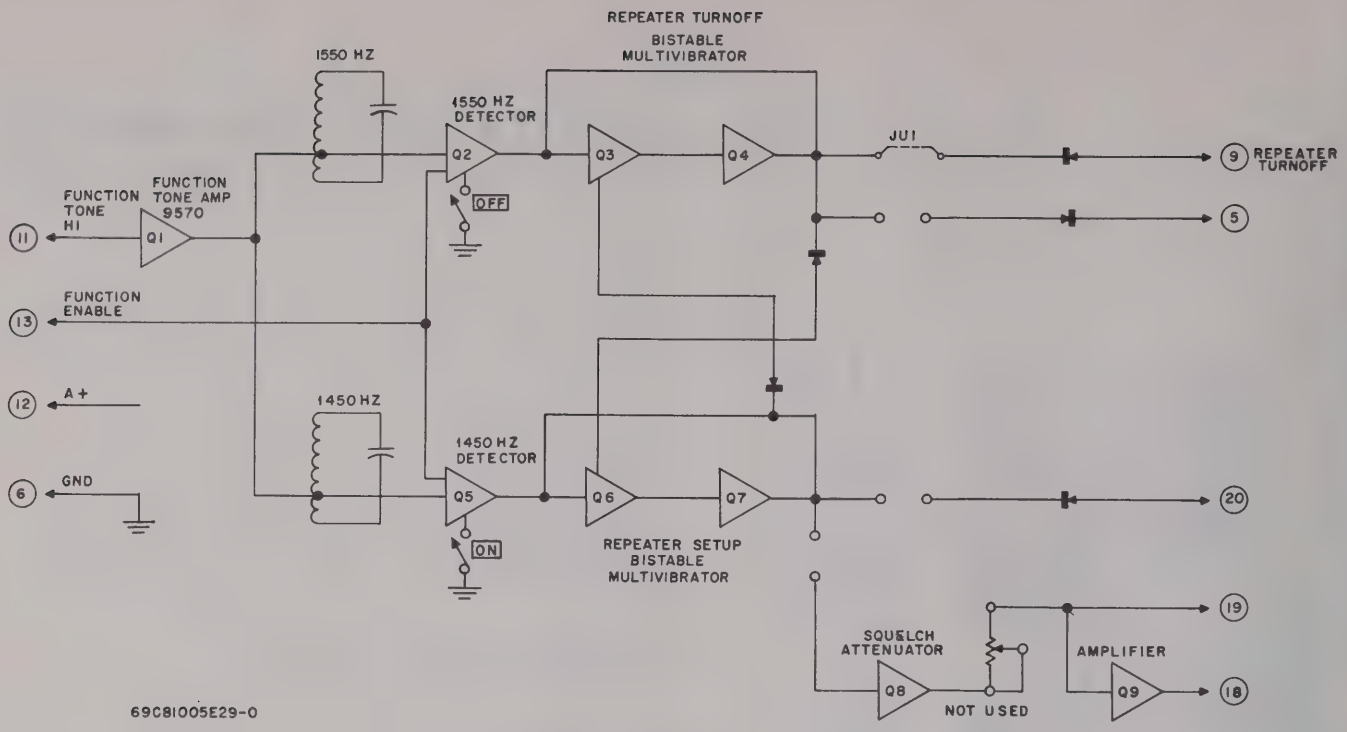
R23	6S2028	2.2K ±5%; 1/2 w
R24	6S129805	1K ±5%
R25	6S128689	2.2K
R26	6S129620	560
R27	6S129620	560
R28	6S127804	4.7K
R29	6S129620	560
R30	6S129228	330K
R31	6S127804	4.7K
R32	6S129231	3.3K
R33	6S131526	18K ±5%
R34	6S131275	220 ±5%
R35	6S2028	2.2K ±5%; 1/2 w
R36	6S129805	1K ±5%
R37	6S128689	2.2K
R38	6S128689	2.2K
R39	6S129620	560
R40	6S129620	560
R41	6S127804	4.7K
R42	6S129620	560
R43	6S127804	4.7K
R44	6S129228	330K
R45	6S6038	1.5K; 1/2 w
R46	6S129231	3.3K
R47	6S6038	1.5K; 1/2 w
R48	6S129231	3.3K
	NON-REFERENCED ITEM	
	42S10217A01	STRAP, cable harness

TLN4049A C2-R2 Decoder Panel Kit — PL-482-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SWITCH, slide:
S1	40B83204B01	dpdt
S2	40B83468E01	spdt
S3	40B83468E01	spdt
	NON-REFERENCED ITEMS	
	1V80703B19	PANEL ASSY (riveted); incl. ref parts S1, S2 and S3
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 13	Ground
9	10K ohms to pin 12
11	Oscillator input
12	A+ 13.6 Volts dc

c. Module Malfunction Location Techniques

(1) Operate Repeater Turnoff Stages

(a) Connect a dc voltmeter from the collector of Q4 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q2. The output level must not exceed 1 volt.

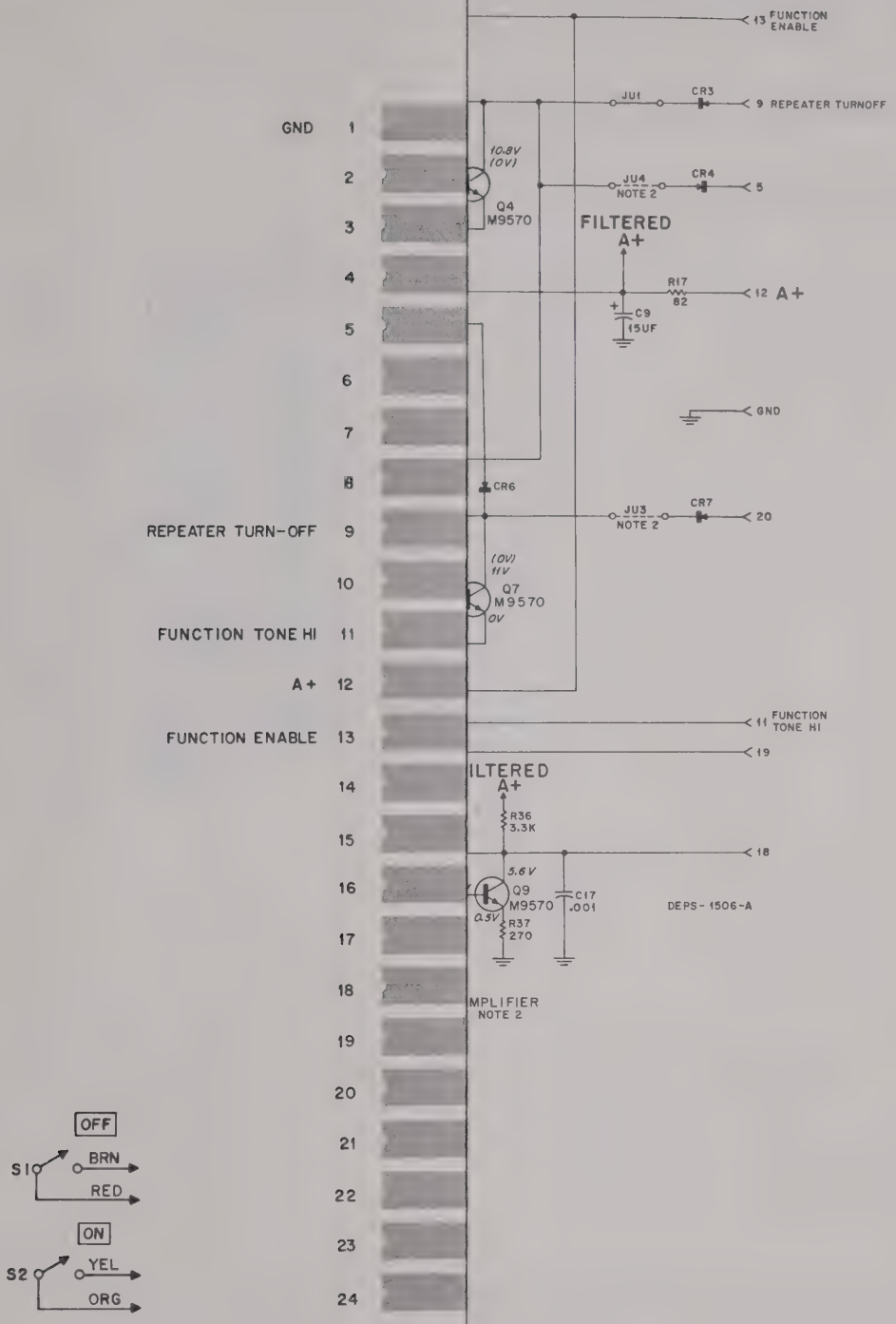
(c) Adjust the audio oscillator frequency to 1550 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage (Q2) then the multivibrator stage (Q3-Q4). If the change of state occurs, look to the function tone amplifier for a malfunction.

(2) Operate Repeater Setup Stages

(a) Connect a dc voltmeter from the collector of Q9 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q5. The output level from the oscillator must not exceed 1 volt.

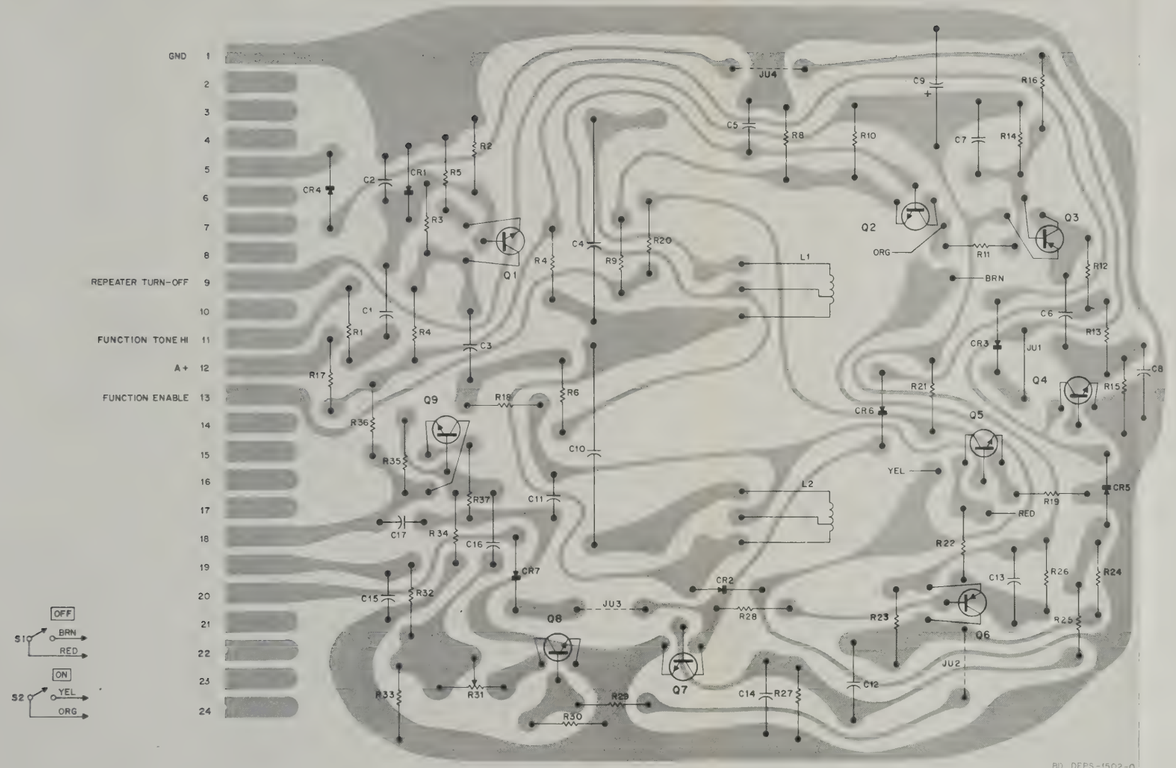
(c) Adjust the audio oscillator frequency to 1450 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage (Q5) then the multivibrator stage (Q6-Q7). If the change of state occurs, look to the function tone amplifier for a malfunction.



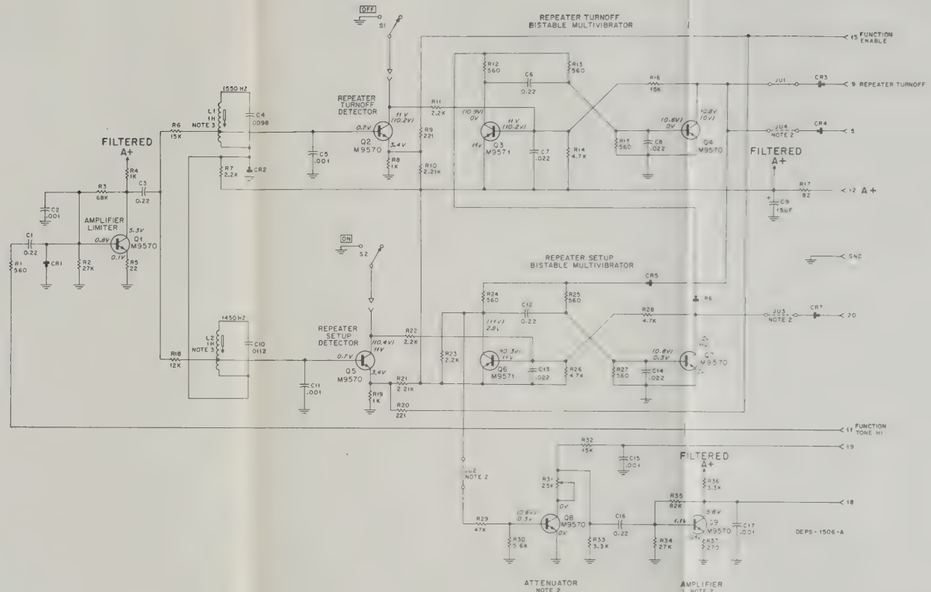
REPEATER CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E04-A
1/2/70-UP



BD-DEPS-1502-O
OL-DEPS-1505-A



NOTES:

1. VOLTAGES IN PARENTHESES ARE FOR ACTIVATED STATE.
2. NOT USED IN THIS CIRCUIT.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.

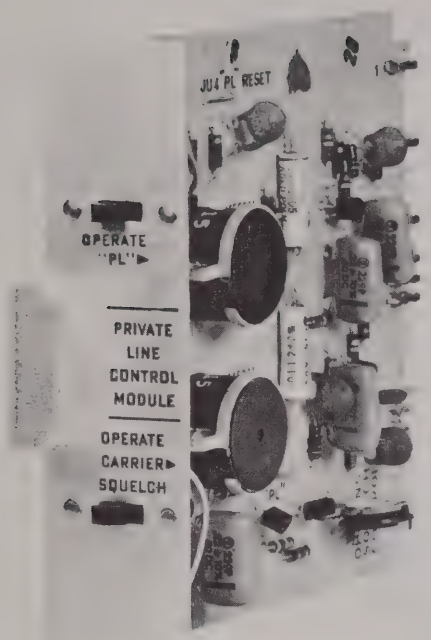
EPS-2086-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E04-A
1/2/70-UP

"PRIVATE-LINE" CONTROL MODULE

MODEL TLN1251A



1. DESCRIPTION

The TLN1251A "Private-Line" Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module provides selection of "Private-Line" tone-coded squelch or carrier squelch operation by tone command from a remote control point. A 1550 Hertz tone selects "Private-Line" operation, while a 1450 Hertz tone selects carrier squelch operation of the receiver.

3. CIRCUIT DESCRIPTION

A 1500 Hz tone entering the module on pin 11 is amplified and clipped in the Function Tone Amplifier stage Q1. After processing, the tone will pass through the tuned circuit L1-C4 into the operate PL detector stage Q2. Upon detection, the operate PL bistable multivibrator Q3-Q4 is turned on. When the bistable multivibrator is actuated, the collector of Q4 goes to ground, generating a negative-going pulse.

The negative-going pulse is applied to the operate carrier squelch bistable multivibrator Q6-Q7 through the diode CR5. This pulse causes the Q6-Q7 bistable multivibrator to change from its saturated state to its cutoff state. Upon deactivation, the Q7 collector, which was at ground potential, rises to approximately 11 volts. While the Q7 collector was at ground, pin 20 was grounded through diode CR7, causing the external PL disable circuitry to be activated. When the ground is removed, the "Private-Line" circuitry is no longer disabled, and "Private-Line" operation becomes functional.

A 1450 Hz tone entering the module on pin 11 is amplified and clipped in the Function Tone Amplifier stage Q1. After processing, the tone can pass into the tuned circuit L2-C10 and then into the operate carrier squelch detector stage Q5. Detection of the tone in this stage causes the operate carrier squelch bistable multivibrator Q6-Q7 to become actuated. When the bistable

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REVISIONS

63P81005E04-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4050A	R6	WAS 6S131526, 18K	L1 TAP
	R9	WERE 6S131275, 220	Q2 EMITTER
	R20		Q5 EMITTER
	R10	WERE 6S129804, 2.2K	Q2 EMITTER
	R21		Q5 EMITTER
	R18	WAS 6S129236, 15K	L2 TAP
TLN4050A-1			

PARTS LIST

TLN4050A Control Board — PL-431-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1, 3, 6, 12, 16	8D82905G11	CAPACITOR, fixed: 0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF +10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
CR1 thru 7	48C82392B03	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon
L1, 2	1V80702B11	REACTOR: AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
Q1, 2, 4, 5, 7, 8, 9	48R869570	TRANSISTOR: (SEE NOTE) N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
R1, 12, 13, 15, 24, 25, 27	6S129620	RESISTOR, fixed: ±10%; 1/4 W; unl. stated 560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S129236	15K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6D84444A07	221 ±1%
R10, 21	6D84444A08	2.21K ±1%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129887	12K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4052A Repeater Control Panel — PL-433-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd.

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

REVISIONS

63P81005E04-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4050A	R6	WAS 6S131526, 18K	L1 TAP
	R9	WERE 6S131275, 220	Q2 EMITTER
	R20		Q5 EMITTER
	R10	WERE 6S129804, 2.2K	Q2 EMITTER
	R21		Q5 EMITTER
	R18	WAS 6S129236, 15K	L2 TAP
TLN4050A-1			

PARTS LIST

TLN4050A Control Board — PL-431-A

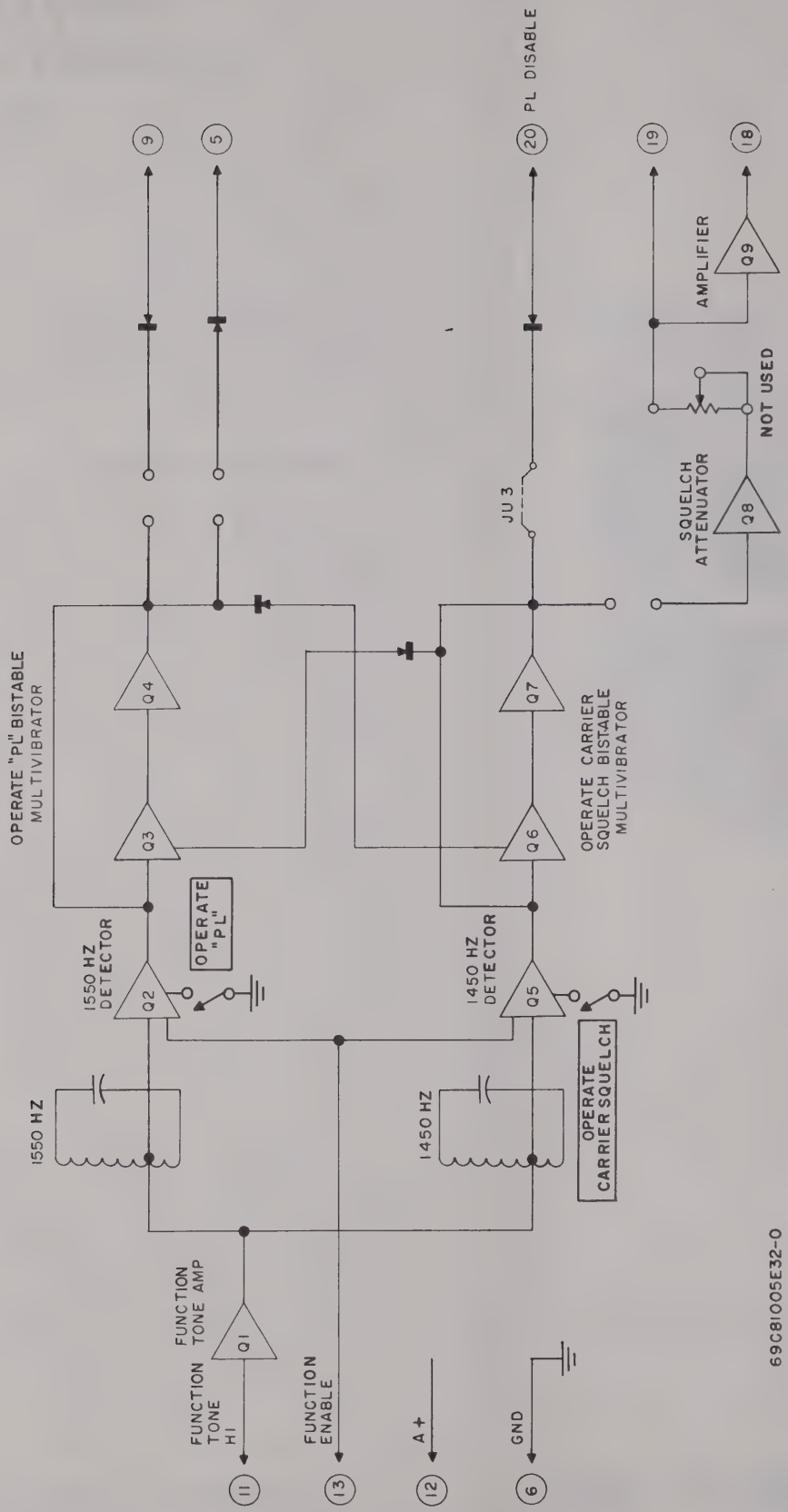
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 3, 6, 12, 16	8D82905G11	0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF +10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon
		REACTOR:
L1, 2	1V80702B11	AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 4, 5, 7, 8, 9	48R869570	N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1, 12, 13, 15, 24, 25, 27	6S129620	560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S129236	15K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6D84444A07	221 ±1%
R10, 21	6D84444A08	2.21K ±1%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129887	12K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4052A Repeater Control Panel — PL-433-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board): 2 req'd.

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

multivibrator changes state, the collector of Q7 goes to ground, and applies a ground to pin 20. This ground is normally applied to the external "Private-Line" disabling circuitry which reverts the equipment to carrier squelch operation.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 13	Ground
11	Oscillator Input
12	A+ 13.6 volts dc
20	10K ohms to 12

c. Module Malfunction Location Techniques

(1) Operate "Private-Line" Tone-Coded Squelch Stages

(a) Connect a dc voltmeter from the collector of Q4 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q2. The output level must not exceed 1 volt.

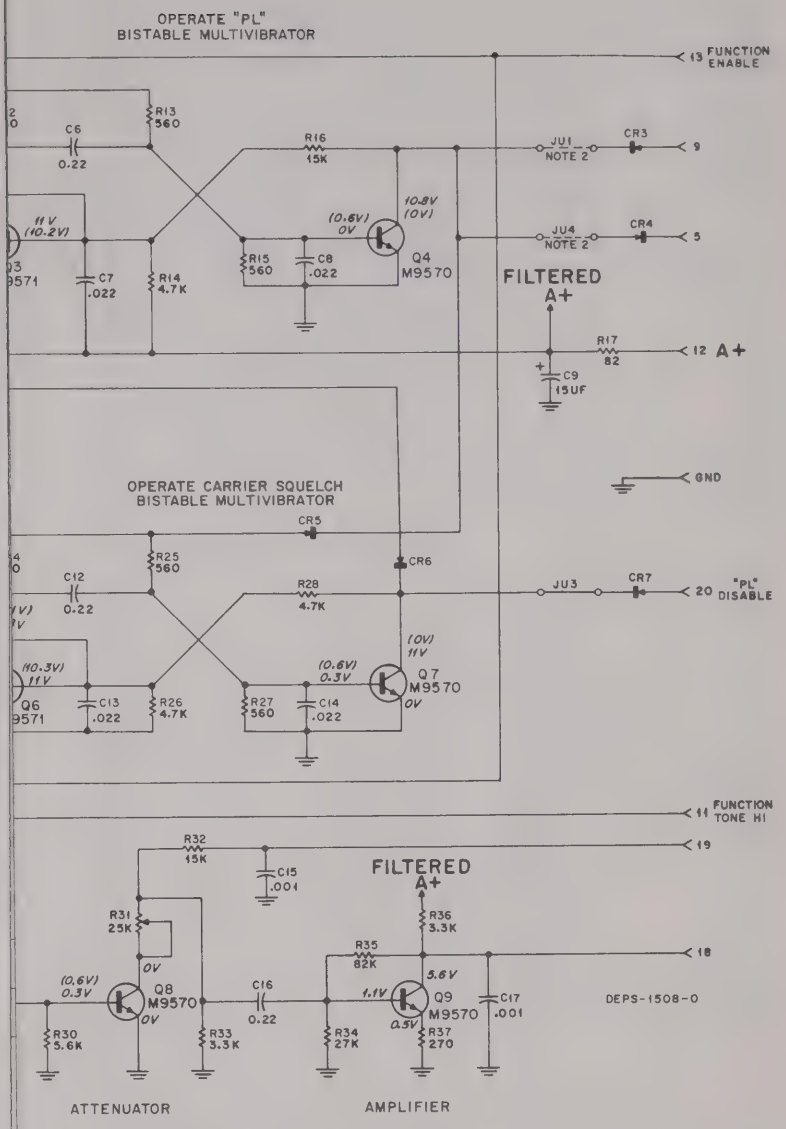
(c) Adjust the audio oscillator frequency to 1550 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage Q2, then the multivibrator stage Q3-Q4. If the change of state occurs, look to the function tone amplifier for a malfunction.

(2) Operate Carrier Squelch Stages

(a) Connect a dc voltmeter from the collector of Q7 to ground.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of transistor Q5. The output level from the oscillator must not exceed 1 volt.

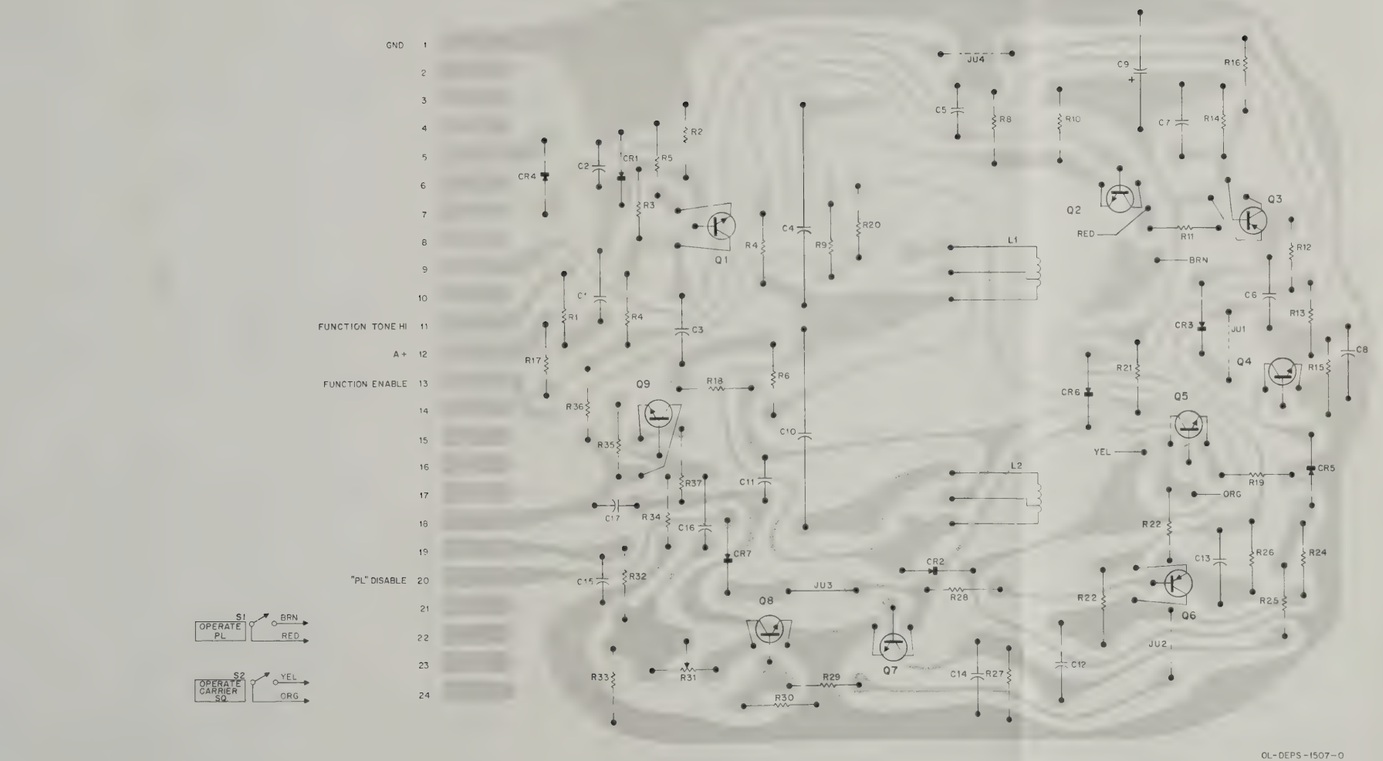
(c) Adjust the audio oscillator frequency to 1450 Hz. The voltmeter reading should fall to zero volts, indicating that the multivibrator has changed state. If the change of state does not occur, check the detector stage Q5, then the multivibrator stage Q6-Q7. If the change of state occurs, look to the function tone amplifier for a malfunction.

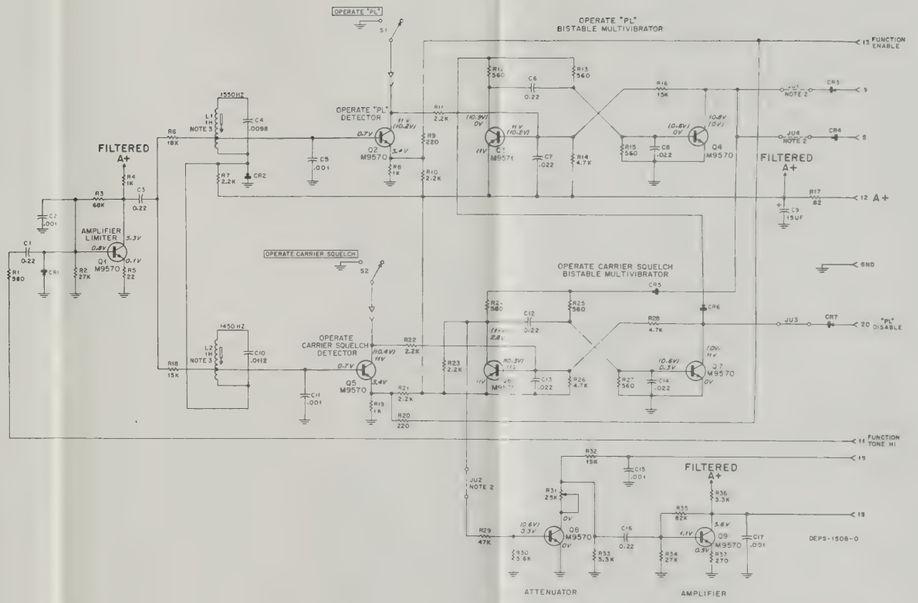


PL CONTROL MODULE

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E12-O
5/17/69-CP





NOTES

1. VOLTAGES IN PARENTHESES ARE FOR ACTIVATED STATE.
2. NOT USED IN THIS CIRCUIT.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.

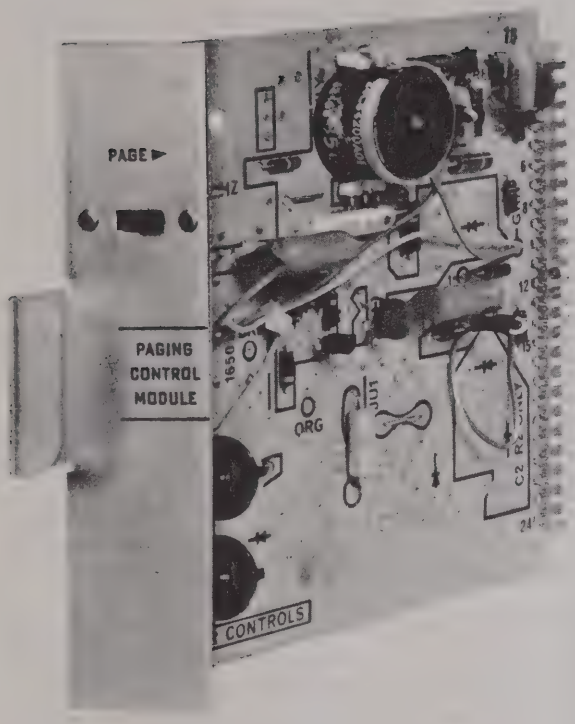
PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
And Circuit Board Detail
Motorola No. 63P81005E12-O
5/17/69-CP

PL CONTROL MODULE

PAGING CONTROL MODULE

MODEL TLN1253A



1. DESCRIPTION

The TLN1253A Paging Control Module is a fully transistorized, plug-in circuit module for the tone remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This module provides "Private-Line" tone inhibiting on tone command from a remote control point for one type of receiver paging. In this system, all receivers in the system would normally hear the network messages with the subaudible "Private-Line" tone. To page the non-PL receivers, an 1850 Hz command tone is sent to the tone remote control chassis, which inhibits the "Private-Line" tone in the transmitter and allows the transmitted message to reach only the non-"Private-Line" receivers.

3. CIRCUIT DESCRIPTION

With a ground applied to the function enable line, pin 13, and switched 8.8 volts present at pin 8, the detector stage Q1 is operational. An 1850 Hz tone entering the module on pin 11 is amplified and clipped in the amplifier stage Q4. With the detector stage operational, the detected tone triggers the Paging Bistable Multivibrator Q2-Q3. When the bistable multivibrator turns on, a ground is applied to pins 1B and 2B.

The ground on pin 1B is conveyed through diode CR1 and pin 10 to activate the T1 channel element bistable multivibrator on the associated F1 Control Module, turning on the transmitter. The same ground applied to pin 14 through pin 2B and diode CR6 inhibits the "Private-Line" tone oscillator. The diode CR1 serves to isolate the F1 Bistable Multivibrator output from triggering the Paging Bistable Multivibrator output when normal (non-paging) transmissions are commanded, and triggers F1 via the Paging Bistable Multivibrator during paging transmissions.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a tone function cannot be performed from the remote control point, the malfunction may be

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PARTS LIST

TLN4050A Control Board — PL-431-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 3, 6, 12, 16	8D82905G11	0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF ±10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon
		REACTOR:
L1, 2	1V80702B11	AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 4, 5, 7, 8, 9	48R869570	N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1, 12, 13, 15, 24, 25, 27	6S129620	560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S131526	18K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6S131275	220 ±5%
R10, 21	6S129804	2.2K ±5%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129236	15K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4053A "PL" Control Panel — PL-434-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board); 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

TLN4050A Control Board — PL-431-O

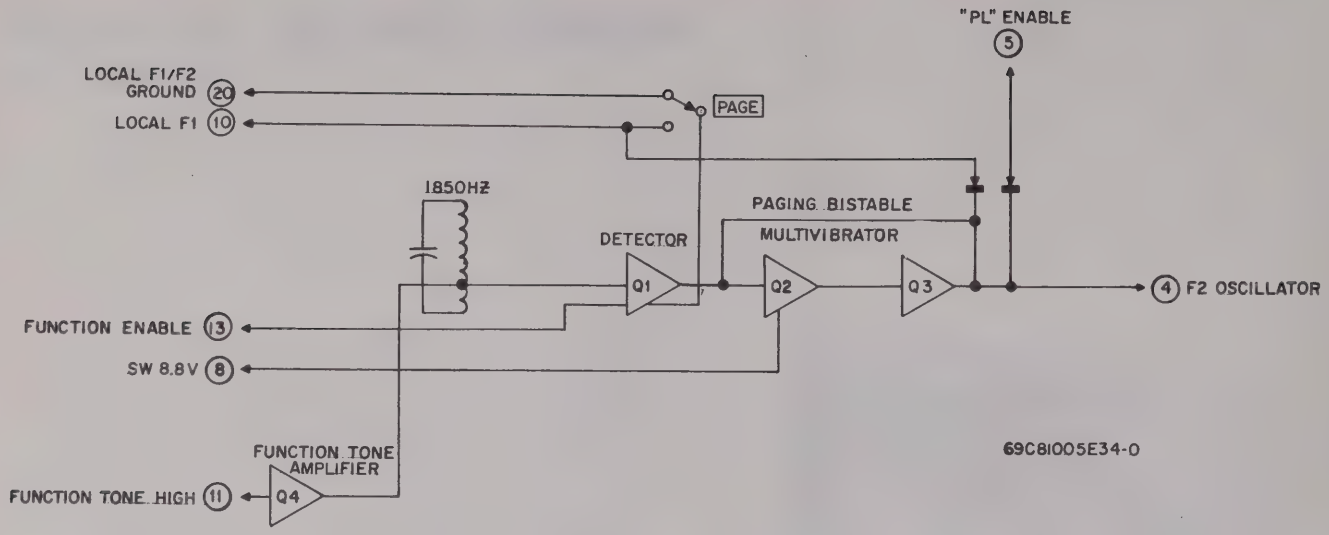
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 3, 6, 12, 16	8D82905G11	0.22 uF ±10%; 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF +10%; 100 V
C4	8D84326A18	.0098 uF ±2%; 50 V
C7, 8, 13, 14	8D82905G02	.022 uF ±10%; 50 V
C9	23K865136	15 uF ±20%; 25 V
C10	8D84326A19	.0112 uF ±2%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon
		REACTOR:
L1, 2	1V80702B11	AF bandpass; (preset at factory); res 140 ohms ±10%; incl. grounding clip
		TRANSISTOR: (SEE NOTE)
Q1, 2, 4, 5, 7, 8, 9	48R869570	N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R1, 12, 13, 15, 24, 25, 27	6S129620	560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S131526	18K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6S131275	220 ±5%
R10, 21	6S129804	2.2K ±5%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129236	15K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K

TLN4053A "PL" Control Panel — PL-434-O

S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board); 2 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Functional Block Diagram

isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 2, 13	Ground
4	10K ohms to pin 12
5	10K ohms to pin 12
8	To pin 12
11	Oscillator input
12	A+ 13.6 volts dc

d. Module Malfunction Location Techniques

(1) Paging Bistable Multivibrator

(a) Connect a dc voltmeter between pin 4 and pin 2.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1850 Hz. The voltmeter reading should fall to zero volts, indicating that the bistable multivibrator has changed state. If the change of state does not occur, check the detector stage Q1, then the bistable multivibrator Q2-Q3. If the change of state occurs, look to the function tone amplifier for a malfunction.

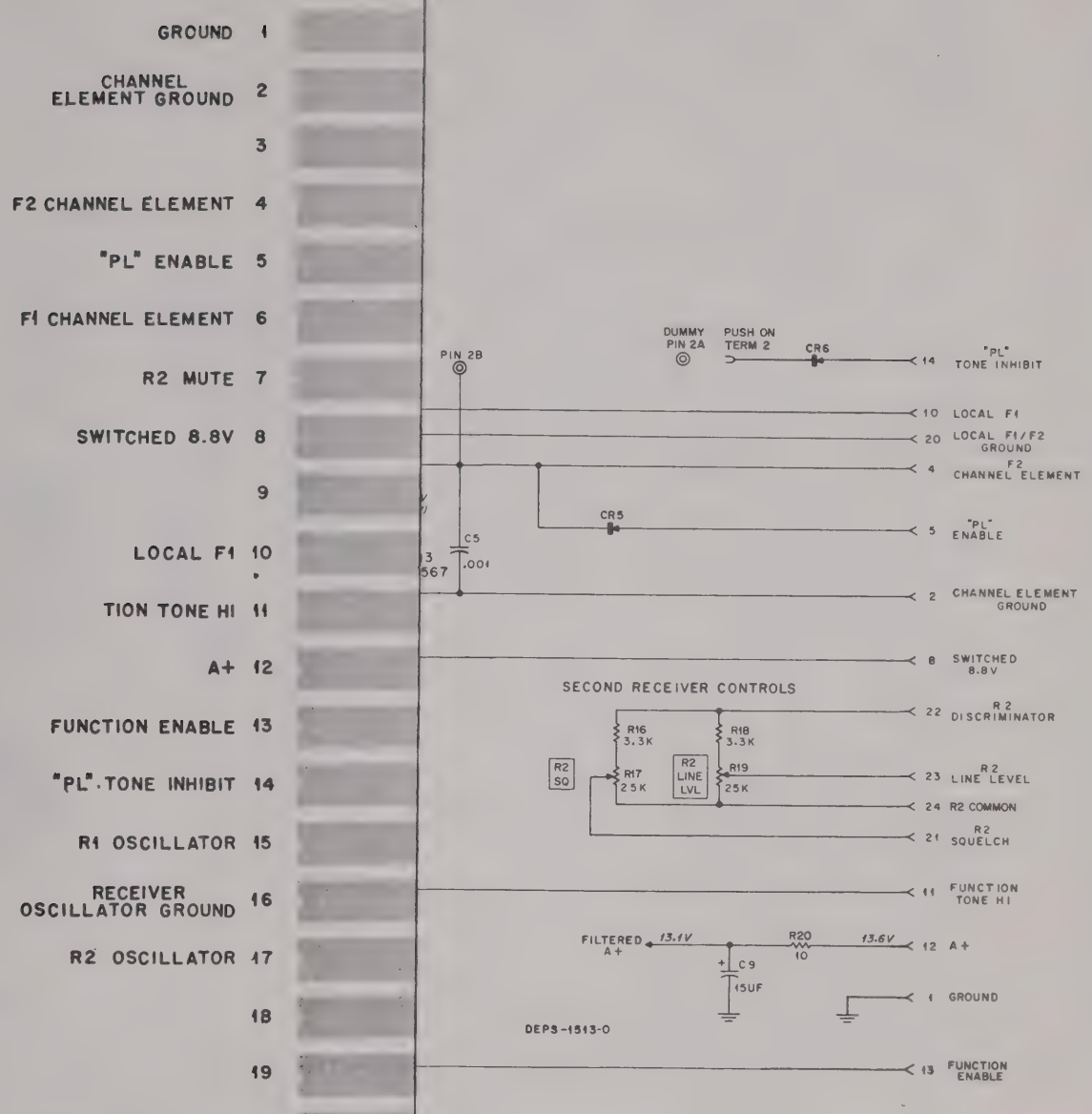
(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q4 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1800 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

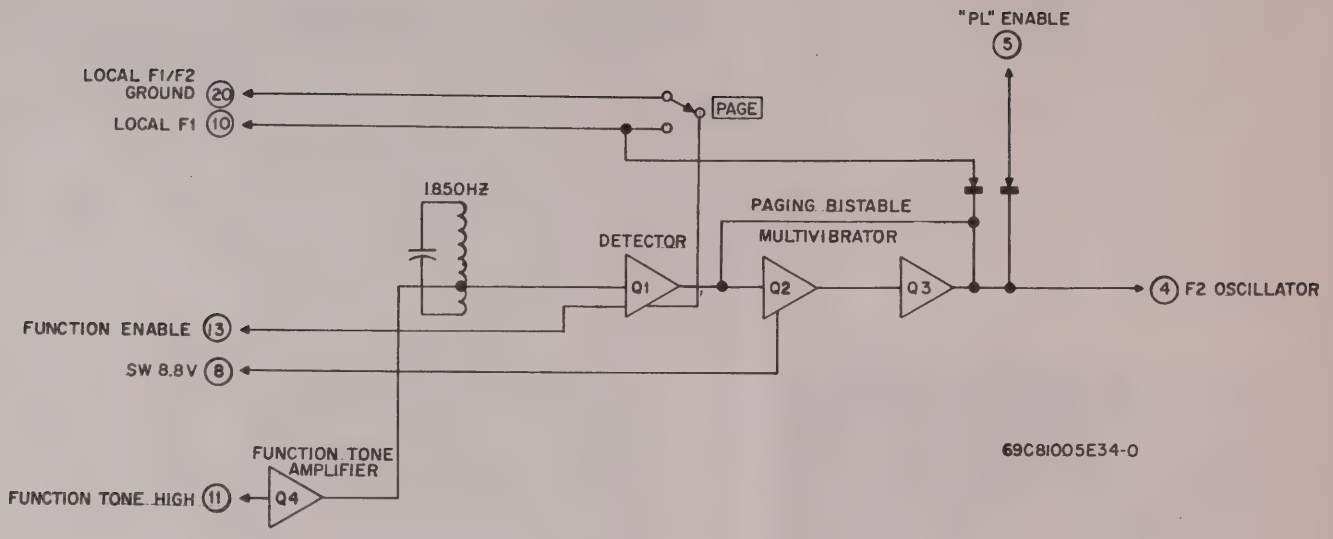
(d) If the aforementioned conditions are not attained, measure the voltages on the function tone detector stage.



PAGING CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81005E17-O
5/17/69-CP



Functional Block Diagram

isolated to either the remote equipment or the remote control chassis. To determine the location of the fault, operate the station locally, and initiate the desired function tone from the module If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NUMBER	CONNECTION
1, 2, 13	Ground
4	10K ohms to pin 12
5	10K ohms to pin 12
8	To pin 12
11	Oscillator input
12	A+ 13.6 volts dc

d. Module Malfunction Location Techniques

(1) Paging Bistable Multivibrator

(a) Connect a dc voltmeter between pin 4 and pin 2.

(b) Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

(c) Adjust the audio oscillator frequency to 1850 Hz. The voltmeter reading should fall to zero volts, indicating that the bistable multivibrator has changed state. If the change of state does not occur, check the detector stage Q1, then the bistable multivibrator Q2-Q3. If the change of state occurs, look to the function tone amplifier for a malfunction.

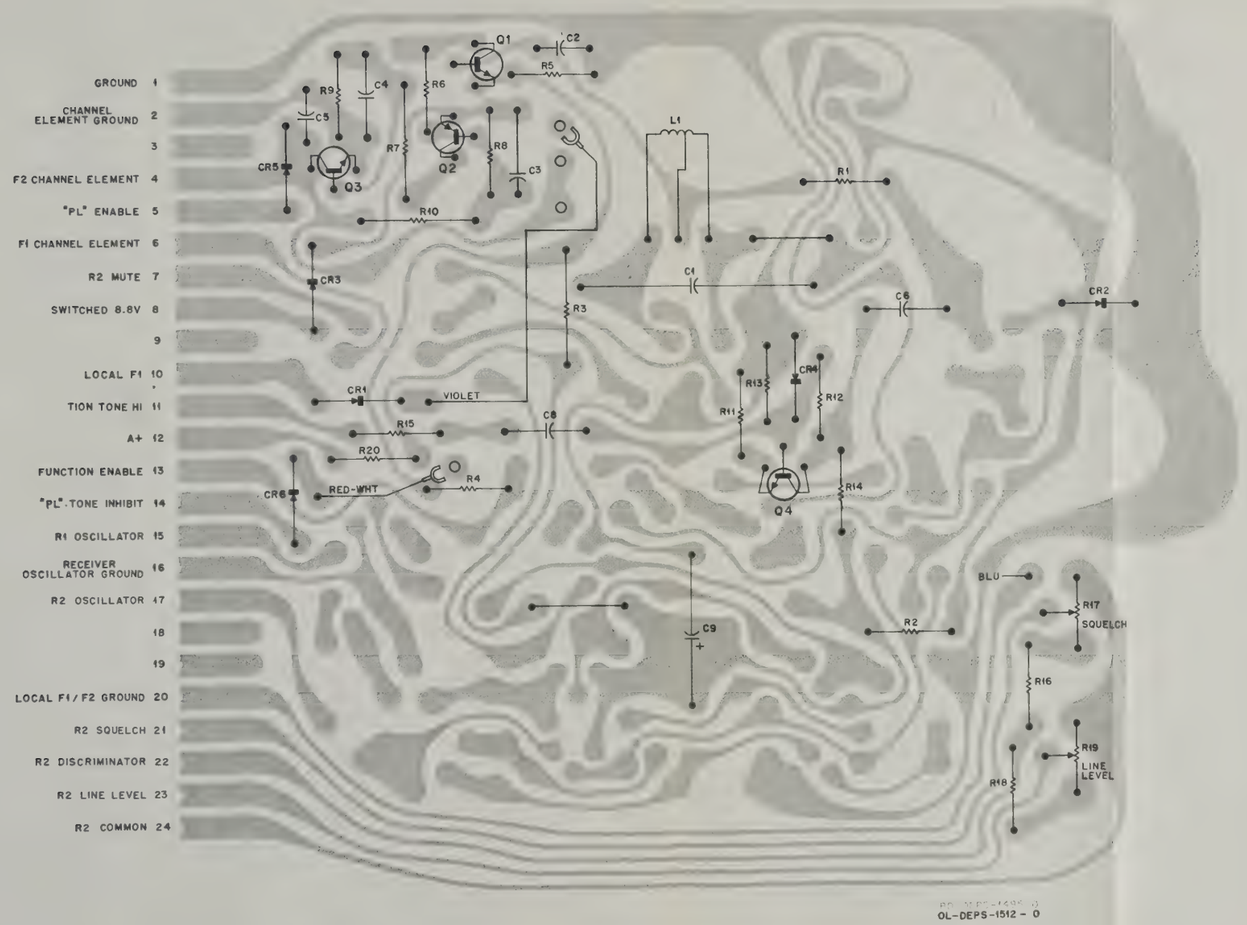
(2) Function Tone Amplifier Stage

(a) Connect an ac voltmeter from the capacitor connected to the collector of Q4 to ground.

(b) Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1800 Hz.

(c) The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

(d) If the aforementioned conditions are not attained, measure the voltages on the function tone detector stage.



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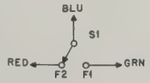
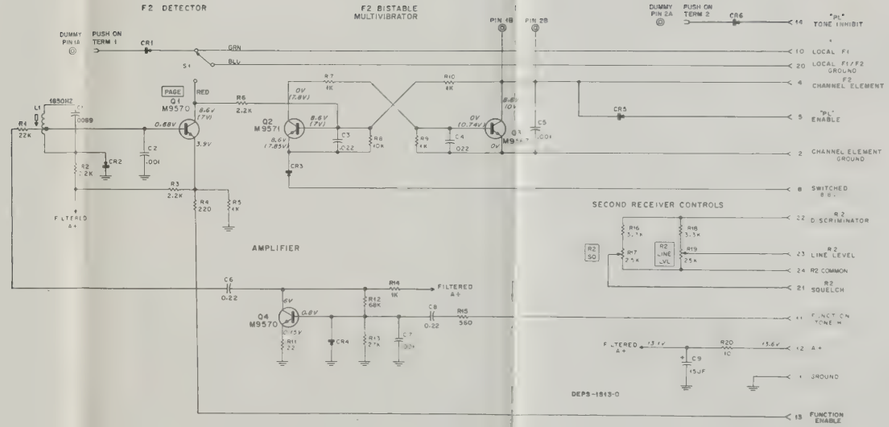




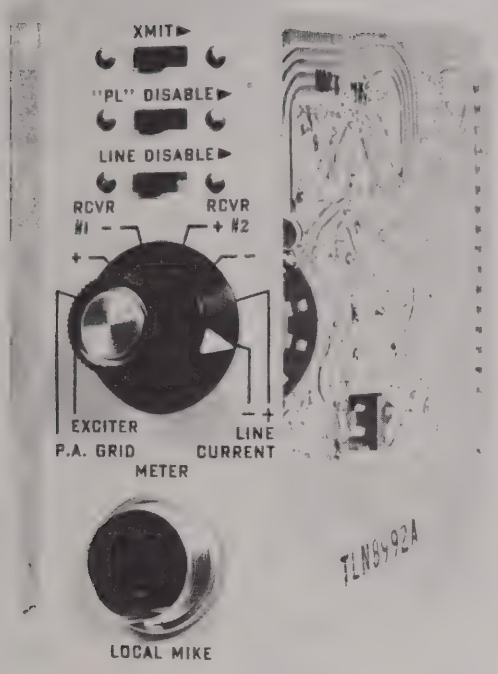
PAGING CONTROL MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram and Circuit Board Detail
Motorola No. 63P81005E17-O
5/17/69-CP

STATION LOCAL CONTROL MODULE

MODEL TLN1231A



1. DESCRIPTION

This module contains local control and metering facilities, a fully transistorized "Private-Line" tone generator, receiver "Private-Line" disable circuit, "Private-Line" reverse burst generator, and the 8.8 v dc reference supply. All components are mounted on a sturdy printed circuit card with connecting pins to mate with the interconnect circuit board on the remote control chassis.

2. CONTROLS AND SWITCHES

a. METER Switch

This switch selects various station circuits for metering as follows:

- EXCITER
- PA GRID
- RCVR #1 (+ and -)
- RCVR #2 (+ and -)
- LINE CURRENT (+ and -)

b. XMIT Switch

To key the transmitter, slide the XMIT switch on the local control panel to the right; to unkey the transmitter, release the switch.

c. "PL" DISABLE Switch

In the normal position (to the left), the "Private-Line" function of the station is operational. In the actuated position (to the right), the receiver "Private-Line" tone-coded squelch circuit is disabled so that all on-frequency signals may be monitored.

d. LINE DISABLE Switch

In the normal position (to the left), station operation can be initiated by remote control. In the actuated position (to the right), remote controls are disabled and the station can only be operated via local controls.

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 W. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4044A F2 Decoder Board — PL-483-O

		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C1	8D84326A15	.0069 ±2%
C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82095G11	0.22
C9	23K865136	15 ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 6	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
R5	6S129805	1K ±5%
R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	variable; 25K
R18	6S129231	3.3K
R19	18C83083G03	variable; 25K
R20	6S129755	10
NON-REFERENCED ITEM		
	42S10217A01	STRAP, cable harness

TLN4056A Paging Decoder Panel Kit — PL-484-O

S1	40B83204B01	SWITCH, slide: dpdt
NON-REFERENCED ITEMS		
	1V80702B25	PANEL ASSY. (riveted): incl. ref. part S1
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

TLN4044A F2 Decoder Board — PL-483-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
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C2	21D82187B29	.001; 100 v
C3	8D82905G02	.022
C4	8D82905G02	.022
C5	21D82187B29	.001; 100 v
C6	8D82905G11	0.22
C7	21D82187B29	.001; 100 v
C8	8D82095G11	0.22
C9	23K865136	15 ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 6	48C82392B03	silicon
		COIL ASSEMBLY, inductor:
L1	1V80702B11	1H; incl. ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; M9570
Q2	48R869571	P-N-P; M9571
Q3	48R869567	N-P-N; M9567
Q4	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	6S129667	22K ±5%
R2	6S128689	2.2K
R3	6S2028	2.2K ±5%; 1/2 w
R4	6S131275	220 ±5%
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R6	6S128689	2.2K
R7	6S6229	1K; 1/2 w
R8	6S129225	10K
R9	6S127802	1K
R10	6S6229	1K; 1/2 w
R11	6S124A08	22 ±5%
R12	6S129299	68K ±5%
R13	6S129886	27K ±5%
R14	6S129805	1K ±5%
R15	6S129620	560
R16	6S129231	3.3K
R17	18C83083G03	variable; 25K
R18	6S129231	3.3K
R19	18C83083G03	variable; 25K
R20	6S129755	10
NON-REFERENCED ITEM		
	42S10217A01	STRAP, cable harness

TLN4056A Paging Decoder Panel Kit — PL-484-O

S1	40B83204B01	SWITCH, slide: dpdt
NON-REFERENCED ITEMS		
	1V80702B25	PANEL ASSY. (riveted): incl. ref. part S1
	45B83914G01	GUIDE, card: 2 used

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

e. LOCAL MIKE Connector

During maintenance and testing, transmissions may be generated locally using a microphone connected to this receptacle. The microphone audio is applied directly to the exciter.

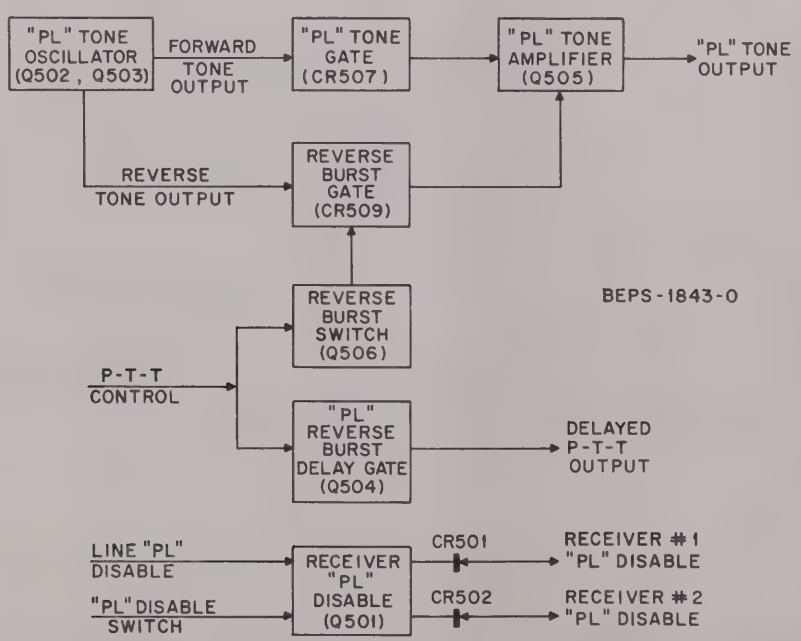
3. "PRIVATE-LINE" TONE GENERATOR

The tone generator consists basically of a two-stage oscillator (Q502 and Q503) and a tone amplifier (Q505). The frequency-determining element of the oscillator is a "Vibrasender" resonant reed (an electromechanical equivalent of a parallel-tuned high Q tank circuit). Tone outputs are obtained from both the emitter and collector of Q503. The two outputs are of opposite phase (the emitter output supplies the "PL" tone for the transmitter during transmission and the collector output supplies the out-of-phase reverse burst tone at the end of a transmission).

Passage of the tone outputs to the base of tone amplifier Q505 is controlled by the "PL" Tone Gate and "PL" Reverse Burst Gate circuits. During a transmission, the "PL" Tone Gate is open, passing the tones from the emitter output of Q503 to tone amplifier Q505 ("PL" Reverse Burst Gate is closed). When the operator releases the push-to-talk switch at the end of a transmission, the "PL" Tone Gate closes, terminating transmission of the "Private-Line" tone. Simultaneously, the Reverse Burst Gate opens, passing the reverse (out-of-phase) tone signal from Q503 to the tone amplifier. The reverse burst tone signal is transmitted for a short interval (approximately 150 milliseconds) to provide a positive damping action for the "Vibrasponder" resonant reed in the receiver(s).

The 150-millisecond delay is developed by "PL" Reverse Burst Delay Gate Q504. It delays the actual unkeying of the transmitter after the operator releases the push-to-talk switch to permit transmission of the short burst of reverse tone. At the end of the delay interval, the "delayed push-to-talk" output signal causes the transmitter to unkey.

An additional circuit (receiver "PL" Disable) disables the receiver(s) "Private-Line" tone-coded squelch operation. Q501 is an inverter which saturates when the receiver(s) "Private-Line" circuit(s) is (are) in use. With Q501 saturated, the receiver #1 and receiver #2 "PL" disable lines are clamped to ground through diodes CR501 and CR502, respectively. The "Private-Line" mode is disabled by application of a ground from the "PL" DISABLE switch. This turns off Q501, removing the ground connection to the "PL" Disable output lines at pins 2 and 3 of J502.



"Private-Line Tone Generator
Block Diagram

a. Standby (Unkeyed) State

In the unkeyed state, the Push-To-Talk Control signal at pin J502-10 is a positive voltage (approximately +12 volts) which is developed in the remote control unit. Diode CR505 is reverse-biased (its cathode is at a higher positive voltage than the anode). The anode voltage for CR505 is taken from a voltage divider comprised of R543, R524, and R525 between the +8.8 volt bus and ground. Approximately +0.6 volt is applied from the voltage divider to the base of reverse burst switch Q506, holding it in saturation. The grounded emitter of Q506 reverse biases CR508, whose cathode is connected via R531 to a positive 3.9-volt tap on a voltage divider (R527 and R529) between the +8.8 volt bus and ground.

With CR508 reverse-biased, the cathode of CR509 assumes a positive voltage much lower than the +5.4 volts on its anode. CR509 is therefore forward-biased when the transmitter is unkeyed. At the same time, the positive voltage at the junction of R524 and R525 is applied via R526 to the anode of CR506, forward-biasing it and applying a positive voltage via R533 to the cathode of CR507 that is sufficient to reverse-bias CR507.

Reverse Burst Delay Gate Q504 is held in saturation. The positive voltage applied at pin J502-10 keeps capacitor C101 essentially uncharged (CR505 being reverse-biased acts as an open circuit). The base voltage of Q504 is approximately 0.7 volt less positive than the A+ voltage at its emitter, forward-biasing the base-emitter junction. The base voltage is determined by a voltage divider comprised of R519, CR503, R517 and R518 between A+ and ground. With Q504 saturated, its collector voltage is 12.7 volts and the Delayed Push-To-Talk signal at pin J502-11 is approximately the same value.

b. Transmit (Keyed) State

When the transmitter is keyed, a ground (nominal zero volts) is applied to the push-to-talk control input (pin J502-10). This ground forward biases CR505, grounding the base of reverse burst switch Q506 and turning it off. The Q506 collector voltage rises to approximately 6.6 volts, forward-biasing CR508 and applying a positive voltage via R532 to the cathode of CR509. This reverse biases CR509, preventing tone signals from C510 from passing through CR509 to the base of tone amplifier Q505. With the ground provided by the P-T-T Control signal, diode CR505 clamps the junction of R524 and R525 to ground, removing the forward bias on CR506. With CR506 cut off, the cathode voltage of CR507 drops to a much lower positive voltage (tapped off the R527 and R529 voltage divider network). With 5.4 volts on its anode, CR507 is forward-biased, allowing the in-phase tone signal to pass through to the base of amplifier Q505. (The complete tone-path is from the emitter of Q503 through JU1, R514, JU2, C506, C507, and CR507 to the base of Q505.)

When the transmitter is keyed, the P-T-T Control signal at Q505 grounds the negative side of C505, causing it to charge rapidly to 12 volts. Reverse Burst Delay Gate Q504 remains on in the transmit mode because its emitter voltage (12.8 volts) is more positive than its base.

c. End of Audio Transmission

When the operator releases the push-to-talk switch at the end of the transmission, the transmitter does not unkey immediately but continues to transmit an rf carrier modulated only by a reverse burst (out-of-phase) "PL" tone for approximately 150 milliseconds. This short burst provides a damping action to the "Vibrasponder" resonant reed in the receiver. Positive damping of the "Vibrasponder" prevents "ringing" (squelch tail) after the normal "PL" tone transmission ends.

The 150-millisecond delay is provided by the Delayed P-T-T output signal of Reverse Burst Delay Gate Q504. When the push-to-talk switch is released, the P-T-T control signal returns to +12 volts. Capacitor C505, which was charged during P-T-T operation, now discharges through R517 and R518, momentarily reverse biasing CR503. This removes drive from Q504 causing it to turn off. The delayed P-T-T signal is then maintained at near ground potential by current through R521 and R522. When C505 becomes completely discharged (approximately 150 milliseoncds) Q504 turns on, again driven by current through R517 and R518. This causes a high positive potential (12.7 volts) to be applied to the ground drive from the Delayed P-T-T circuit, resulting in transmitter turn-off.

d. "Vibrasender" Resonant Reed

The "Vibrasender" resonant reed is the frequency-determing element of the "Private-Line" oscillator for the transmitter. It maintains the oscillator frequency accurate within ±0.15% of the required frequency.

The reed is a precision built device. The entire assembly is spring-mounted and hermetically

sealed in a metal housing to insure long life at peak performance under all types of conditions. The design of the reed eliminates the need for servicing throughout its useful life.

e. Servicing

There are no special adjustments involved. Servicing is a matter of detecting and replacing defective components.

It is recommended that the serviceman keep a record of the test performed, voltage readings and other pertinent servicing data, each time the "PL" Tone Generator is serviced. This will serve as a guide to normal operating conditions of the tone generator.

(1) Recommended Test Equipment

The following pieces of test equipment (or their equivalents) are required for this procedure.

(a) Motorola Solid-State AC Voltmeter.

(b) Motorola Solid-State DC Multimeter.

(c) Motorola Model T1015A General Purpose Oscilloscope.

(d) Motorola Model SLN6221A Tone Generator.

(2) Access to Circuitry

To gain access to the "Private-Line" circuitry for test, component replacement, or troubleshooting, proceed as follows:

(a) Open the front door of the remote control chassis by turning two turnlatches counterclockwise and swing the door to a horizontal position. Lift up on both side latches and let the door down to a vertical position.

CAUTION

Turn main power switch "OFF" before removing or inserting modules to prevent transistor damage.

(b) Remove the station logic module by grasping it by its handle and gently pulling straight out.

(c) Remove the two mounting screws on the station local control module.

(d) Grasp the module by its side and pull straight out.

(e) Replace the station logic module back in its guide rails and slide the card in until it mates with the pins of the interconnect printed circuit board on the rear of the remote control chassis.

(f) Extend the station local control module using the Motorola TLN8799A PC Servicing Board.

(g) Insert the combination service board and module into the guide rails, sliding them until the service board mates with the interconnect printed circuit board on the remote control chassis.

The module is now ready for power application and its circuitry is exposed for troubleshooting and circuit tracing. Upon completion of service, remove the service kit, and replace the station local control module in its proper location, securing it with the mounting screws previously removed.

(3) "Vibrasender" Resonant Reed Check

(a) Remove the "Vibrasender" resonant reed from the "Private-Line" tone generator and insert it into the socket provided on the SLN6221A "Private-Line" Tone Generator.

(b) Externally modulate the rf output of an FM signal generator by applying the output from the SLN6221A Tone Generator. Adjust the signal generator deviation for 0.5 to 1 kHz. If the "Vibrasender" is defective, there will be no output from the tone generator.

(4) Performance Checks

(a) If the "Private-Line" tone deviation is not 0.5 to 1 kHz, compare voltage readings with those in Table 1.

TABLE 1.
TYPICAL "PL" TONE GENERATOR AC VOLTAGE READINGS

METERING POINT	TYPICAL READING (mV ac unless otherwise indicated)
Tone Oscillator (Q502) Base	150
Tone Oscillator (Q502) Emitter	12
Tone Oscillator (Q502) Collector	1.2 v ac

TABLE 1.
TYPICAL "PL" TONE GENERATOR AC VOLTAGE READINGS (CONT'D)

METERING POINT	TYPICAL READING (mV ac unless otherwise indicated)
Tone Oscillator (Q503) Base	630
Tone Oscillator (Q503) Emitter	630
Tone Oscillator (Q503) Collector	300
Across Primary of Resonant Reed	90
Junction CR105, C507, R553, R528	570
Tone Amplifier (Q505) Base	150
Tone Amplifier (Q505) Emitter	150
Tone Amplifier (Q505) Collector	530

(b) There should be no "squelch tail" (noise burst from the speaker when the push-to-talk switch is first released).

(5) Localizing the Defective Component

(a) Tone Generator Circuit

If transmitter deviation with "PL" tone applied is improper, check the tone oscillator and tone amplifier circuits. Signal levels may vary widely depending upon the frequency of the "Vibrasender" resonant reed. The phase of the output signal from the tone generator should reverse when the transmitter is keyed and revert to the original condition immediately when unkeyed.

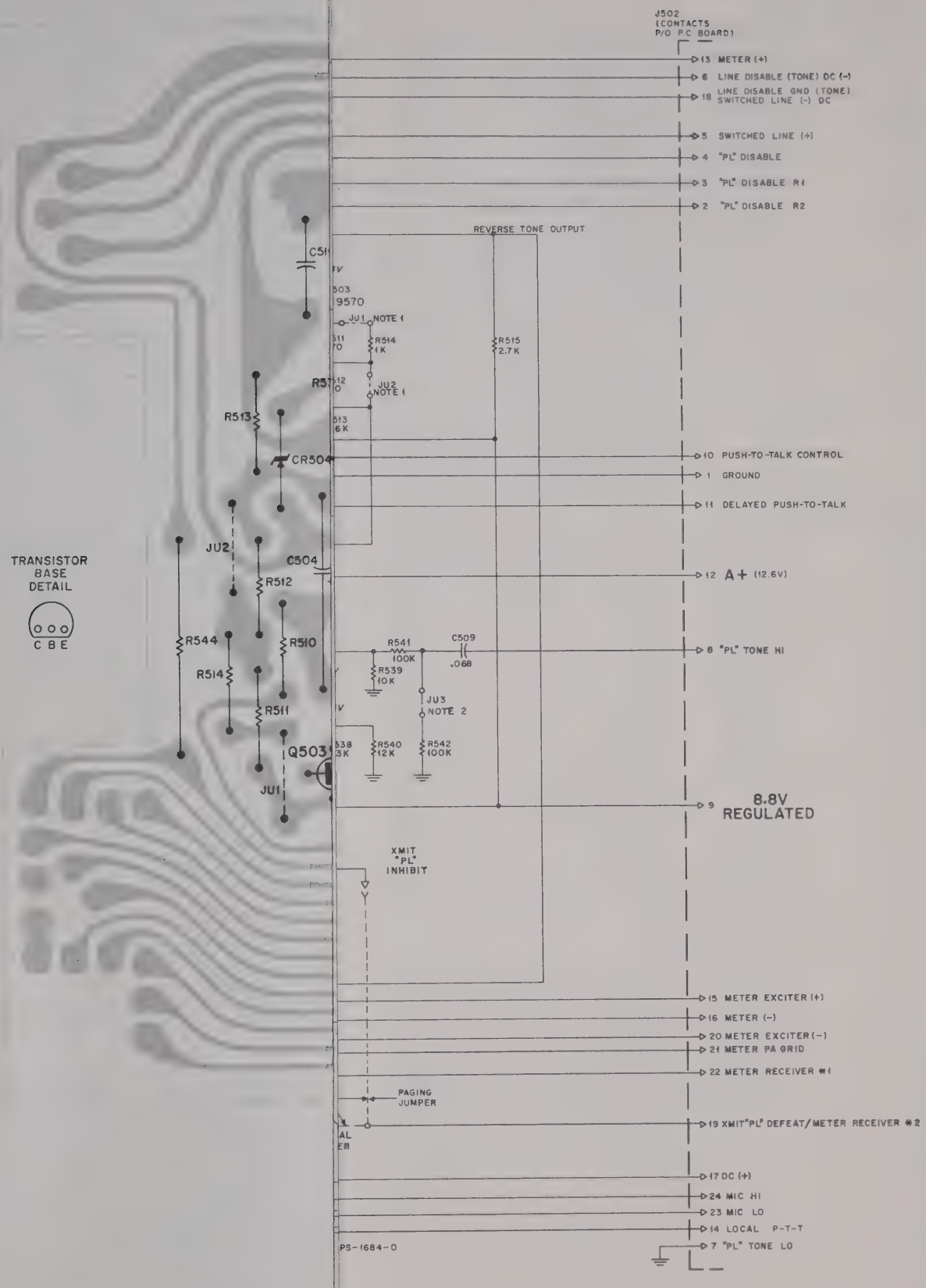
(b) Transmitter "PL" Oscillator Voltage Measurements

Refer to the schematic diagram for dc voltage readings. Adverse effects on oscillator performance can occur if the measured voltages are not up to the level indicated.

(c) Transmitter Tone Deviation

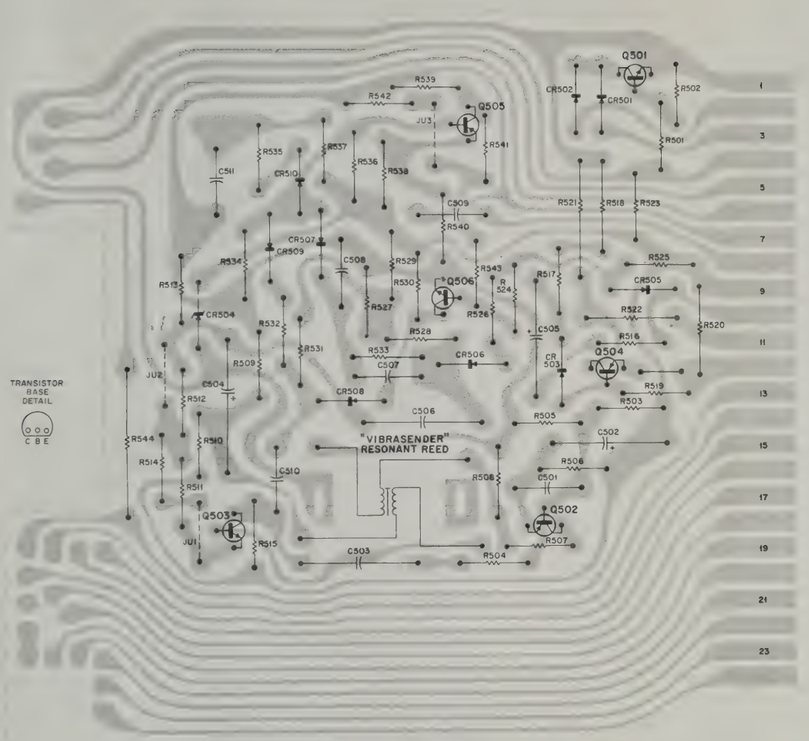
The IDC ("Instantaneous Deviation Control") Adjustment Procedure in the EXCITER-DRIVER section in this manual may be used to determine proper operation of the "PL" oscillator. Refer to this procedure for detailed information concerning measurement of "Private-Line" tone deviation. If this procedure indicates insufficient (or lack of) tone deviation and the transmitter modulates normally with an audio input, check the "PL" oscillator circuit for incorrect voltages or resistances to locate the defective component.

If all voltage and resistance readings are correct, check the "Vibrasender" resonant reed.



PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLN1231A Station Local Control Module
Schematic Diagram and Circuit Board Detail
Motorola No. 63P81003E27-O
5/17/69-GM



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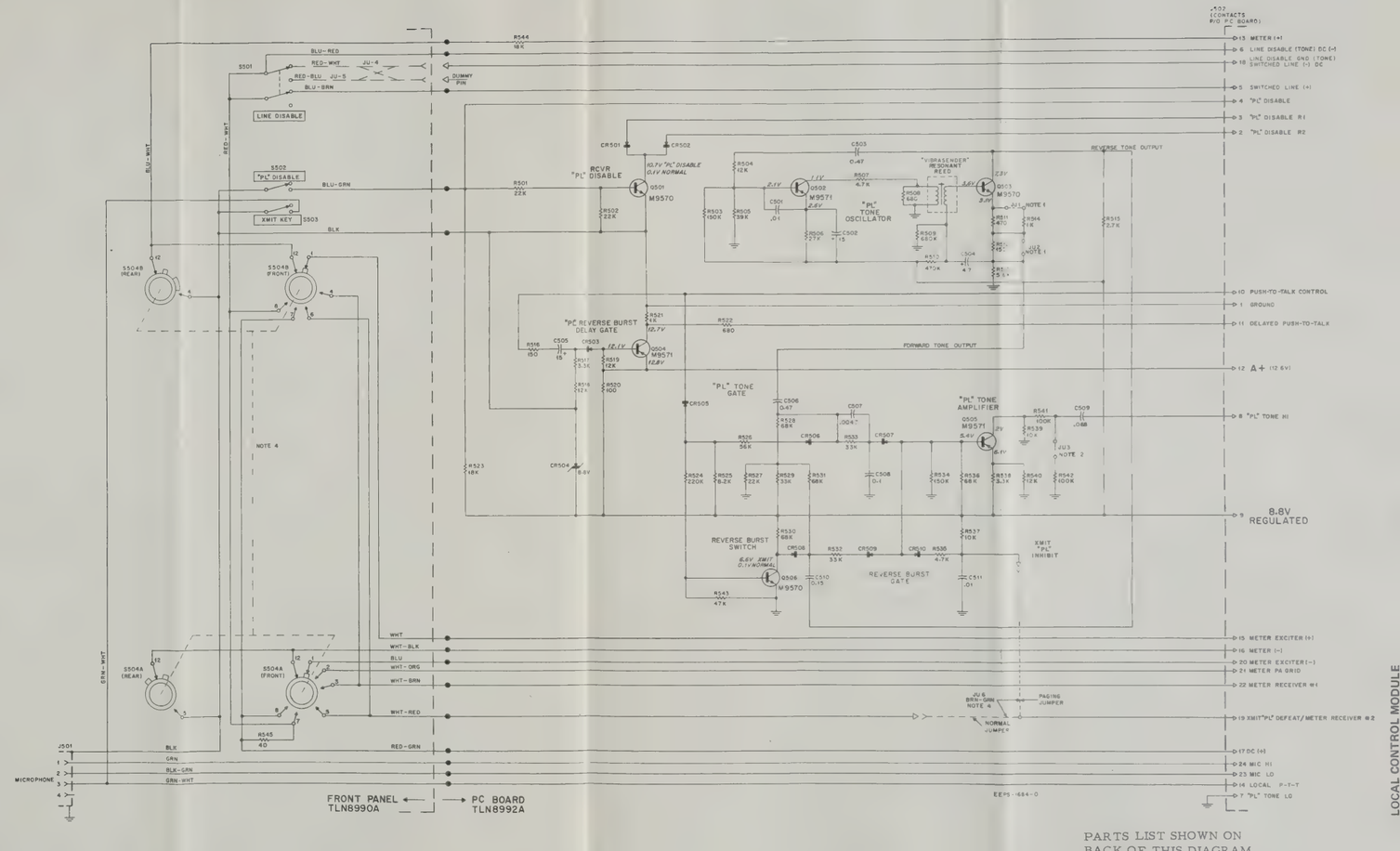
NOTES:

1. JUMPERS JU1, JU2 ADJUST "PL" TONE LEVEL.
2. JUMPER JU3 USED IN NARROW BAND EQUIPMENT ONLY.
3. JU4 & JU5 APPLICATIONS

APPLICATION	JU4	JU5
DC Control	in circuit	Connected to dummy pin
Tone Control	Connected to dummy pin	in circuit

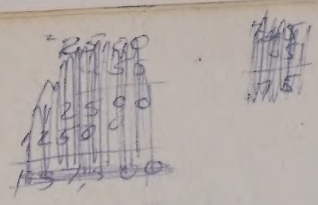
4. JU6 CONNECTED TO PAGING POSITION FOR "PL" XMTR DISABLE IN PAGING APPLICATIONS ONLY.
5. S504A, S504B SHOWN IN EXCITER POSITION.
6. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000)
   CAPACITOR VALUES ARE IN MICROFARADS
   VOLTAGES ARE MEASURED WITH A 20,000 OHMS/VOLT METER AND ARE REFERENCED TO CHASSIS GROUND.

EPS-1807-O



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1231A Station Local Control Module
Schematic Diagram and Circuit Board Detail
Motorola No. 63P81003E27-O
5/17/69-GM



5.5
25
275
110
1375

137.5
5.5
1430

25.00 TREES
1.38 TAX
1.00 TAX
4.00 MOONS
31.38

1.38
55

31.375
5.5
31.4300

PARTS LIST

TLN8992A Metering & "PL" Encoder Board PL-418-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C501, 511	8D82905G01	.01 uF ±10%; 50 v
C502	23K865136	15 uF ±20%; 25 v
C503, 506	8D82905G33	0.47 uF ±20%; 50 v
C504	23K865137	4.7 uF ±10%; 25 v
C505	23D82783B24	15 uF ±10%; 25 v
C507	8D82905G26	.0047 uF ±10%; 100 v
C508	8D82905G07	0.1 uF ±10%; 50 v
C509	8D82905G04	.068 uF ±10%; 50 v
C510	8D82905G05	0.15 uF ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR501, 502, 503, 505 thru 510	48C82392B03	silicon
CR504	48C82256C56	silicon; Zener type
		TRANSISTOR: (SEE NOTE)
Q501, 503, 506	48R869570	N-P-N; type M9570
Q502, 504, 505	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±5%; 1/4 w; unl stated
R501, 502	6S128685	22K ±10%
R503, 534	6S128683	150K
R504, 518, 519, 540	6S129887	12K
R505	6S129777	39K
R506	6S129886	27K
R507	6S129669	4.7K
R508	6S129984	680
R509	6S131857	680K
R510	6S129149	470K
R511	6S129709	470
R512	6S131276	150
R513	6S129982	5.6K
R514	6S129805	1K
R515	6S129707	2.7K
R516	6S129862	150 ±10%
R517, 538	6S124A60	3.3K
R520	6S6326	100 ±10%; 1/2 w
R521	6S6411	1K; 1/2 w
R522	6S5651	680; 1/2 w
R523	6S131526	18K
R524	6S129147	220K ±10%
R525	6S128686	8.2K ±10%
R526	6S128684	56K
R527	6S129667	22K
R528, 530, 531, 536	6S129299	68K
R529, 532, 533	6S129526	33K
R535	6S127804	4.7K
R537	6S129225	10K ±10%
R539	6S129668	10K
R541, 542	6S124A97	100K
R543	6S128902	47K ±10%
R544	6K892470	18K ±10%; 1/2 w
	NON-REFERENCED ITEMS	
	9B83011H01	TERMINAL, slide cont: female ("edge cont")
	9A83445D01	TERMINAL, cont: male; "pin" type

TLN8990A Panel & Switches Kit PL-419-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J501	9K830418	CONNECTOR, receptacle: female; 4-cont; does not include: 29S5279 LUG, soldering: 7/8: i.d. 4S7699 LOCKWASHER: 13/16" internal type 2A482070 NUT, machine: knurled ring type
		RESISTOR, fixed:
R545	17C82036G31	40 ±2%; 2 w
		SWITCH,
S501	40B83204B01	slide: dpdt
S502, 503	40B83468E01	slide: spdt; spring return
S504	40C83252B01	rotary: special switching arrangement; includes:
S504A		front wafer
S504B		rear wafer
		does not include: 4S7691 LOCKWASHER: 3/8" internal type 2S1376 NUT, machine: 3/8-32 x 1/2" hex 36B82631H03 KNOB, control
	NON-REFERENCED ITEM	
	45B83914G01	RAIL, guide: (plastic)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.